# SHARNBASVA UNIVERSITY

**Regulations Governing the Degree of Bachelor of Technology (B. Tech.)**
**Under Outcome Based Education (OBE) & Choice Based Credit System (CBCS)**
**Effective from Academic year 2021-2022**

## 1. DEFINITIONS OF KEY WORDS:

The following are the definations/descriptions that have been followed for the different terms used in Regulations of B. Tech. Programme.

i. "**University"** means the Sharnbasva University, Kalaburagi.

ii. "**Academic Year"** is divided into three semesters viz; Two main semesters (Odd and Even Semesters) and One supplementary semester (also called as summer semester).

iii. "**Semester"** Duration of each main semester will be of 19 weeks and that of a supplementary semester will be of 8 weeks. The activities in each semester shall include: (a) Registration of courses in the first week of semester, dropping the courses in the middle and withdrawal from courses towards the end by the students, under the advice of faculty, (b) Teaching, learning, examination and evaluation.

iv. "**Choice Based Credit System" (CBCS)** means Choice Based Credit System which provides choice for the students to select from prescribed courses (core, electives and foundation courses)

v. "**Credit Based Semester System" (CBSS)** Under the CBSS, the requirement for awarding a degree or certificate is prescribed in terms of number of credits to be earned by the students.

vi. "**Course or Subject"** Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weightage. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures / tutorials / laboratory work / field work / outreach activities / project work / internship training / viva / seminars / term papers / assignments / presentations / self-study etc. or a combination of some of these including online courses.

vii. "**CIE"** and **"SEE"** means respectively the Continuous Internal Evaluation and Semester End Examination of the University.

viii. "**First Attempt"** referred to a student who has completed all formalities and passed all the heads in SEE in single attempt, shall be considered as first attempt.

ix. "**Convocation"** means the convocation of the University, where the Degrees, Honorary Degrees, Diplomas, Academic Distinctions and Certificates are awarded as per the requirements of the University.

x. "**Letter Grade"** means an index of the performance of students in a said course. Grades are denoted by letters O, S, A, B, C, D, E and F.

xi. "**Grade Point"** means a numerical weight allotted to each letter grade on 10-point scale.

xii. "**Credit"** means a unit by which the course is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture)/tutorial or two hours of practical work/field work etc., per week.

xiii. "**Credit Point"** means the product of grade point and number of credits for a course.

xiv. "**Semester Grade Point Average" (SGPA):** It is a measure of academic performance of student/s in a semester. It is the ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

xv. "**Cumulative Grade Point Average" (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points earned by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

xvi. "**Programme"** means an educational programme leading to award of a degree or certificate or diploma.

xvii. "**Transcript or Grade Card or Certificate":** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

xviii. "**Notification"** means the notification of the University.

xix. "**Degree"** means a degree awarded by the University with or without specialization and/ or Minor.

xx. "**Students"** means a person admitted to and pursuing a specified programme of study in the University.

xxi. "**Teacher", "Course Instructor"** means respectively a faculty appointed for imparting instruction and research guidance to students in the University and the Teacher instructing a Course.

xxii. "**OBE**", means **Outcome Based Education.**

xxiii. **"AICTE"** means the All India Council for Technical Education.

xxiv. **"MHRD"** means the Ministry of Human Resource and Development.

xxv. **"Government"** means the Government of Karnataka.

xxvi. **"UGC"** means the University Grants Commission established at New Delhi by an Act of Parliament in 1956.

## 2. ACADEMIC YEAR:

i. The academic year is divided into three semesters viz; Two main semesters (Odd and Even Semesters) and One supplementary semester. Duration of each main semester will be of 19 weeks and that of a supplementary semester will be of 8 weeks.

ii. The activities in each semester shall include: (a) Registration of courses in the first week of semester, dropping the courses in the middle and withdrawal from courses towards the end by the students, under the advice of faculty, (b) Teaching, learning, examination and evaluation.

## 3. SEMESTER SYSTEM AND CHOICE BASED CREDIT SYSTEM:

i. Semester wise credit based system shall be followed in each program of study except in the case of certificate and non-degree programs.

ii. Every course offered shall have four components associated with the teaching-learning process, viz; Lecture-L ,Tutorial -T, Laboratory –P, Self-study-S/Assignments-A.

iii. Credits shall be assigned to each course in a programme of study is as follows: L- One hour lecture =One credit ; T- One hour Tutorial=One credit ; P- Two hours of laboratory /Seminar = One credit ; S/A- Four hours of Self- study/ Assignments = One credit.

iv. Each course in a programme of study shall be represented as L-T-P-S-C , where L, T, P, S, and C means respectively, number of lecture hours per week , number of tutorial hours per week , number of laboratory /seminar hours per week , number of self- study hours per week, and the number of credits assigned to the course.

v. **A course shall have either or all the four components**. Consider the Following example; (1) A course may have only lecture component of 4 hours per week, then it will be represented ,as 4:0:0:0:4 . (2) A course may have 3 hours of lecture and one hour of tutorial, then it will be represented as 3:1:0:0:4. (3) If, the course, has only laboratory component of 2 hours duration and one hour of tutorial, then it will be represented, as 0:1:2:0:2. (4) For Self-Study/ Assignments course of 4 hours duration, then it will be repented as 0:0:0:4:1.

vi. The number of credits required to be earned for degree programme shall be calculated at an average of **TWENTY** credits per main semester. For example, a **four** year degree programme shall comprise of **eight** main semesters and therefore require 160 credits, for three year degree programme shall comprise of **six** main semesters and therefore require 120 credits, and for degree programme of **five** years, the number of credits required to be earned shall be 200. For lateral entry, the number of credits required to be earned shall be 120 ( for four year degree programme).
A variation of 10% credits is allowed.

vii. A full time student shall normally register for a minimum of **18** credits and maximum of **22** credits during main semester, whereas in supplementary semester a maximum of 12 credits.

viii. Every course in a programme of study normally runs for the full length of a semester.

## 4. ADMISSION:

Admission to the University shall normally be made at the commencement of each academic year for various programmes of study except research programmes. The date for advertisement, entrance examination, if any, counseling, admission, registration, commencement of classes, and other details for the academic session shall be notified by the Registrar, from time to time.

## 5. ELIGIBILITY FOR ADMISSION:

The Admission of students to various programmes of studies offered by the University shall fulfill the minimum qualifications laid down by the University, GoK, AICTE, UGC and MHRD for the programme of study concerned, subject to Rules of reservation for candidates belonging to SC, ST, and other Backward Classes as laid down by the State Government from time to time.

## 6. ADMISSION PROCESS:

Admission process for various programmes shall be as follows:

i. Admission to I year / I semester professional programmes (B.TECH, B.ARCH., BCA, BBA etc.) shall be open to the candidates who have passed the second year PUC or XII standard or Equivalent examination recognized by the University

ii. NRI/PIO/FN seeking admission to the above professional programmes shall apply separately with equivalency/eligibility/migration certificate along with passport/visa/clearance/NOC from concerned bodies to the Admission Committee. Only after the eligibility is ascertained, a NRI/PIO/FN can appear for the entrance test conducted by the University.

iii. A candidate seeking admission under the Government Quota shall follow the procedures of the Common Entrance Test (CET) as notified by the Government of Karnataka from time to time, and NATA/JEE ranks for B.Arch.

iv. A candidate seeking admission under the University Quota (Management Quota) shall appear for entrance test conducted by the University by submitting application form and paying the prescribed entrance test fee. However, the students who have cleared and obtained rank in KEA/CET/JEE paper I&II/NATA etc., need not write the University Entrance Exam.

v. Admission Committee shall prepare a merit list for each of programme of study subject to a minimum performance criterion in the entrance test as prescribed by the admission committee from time to time, and the percentage of marks obtained in the qualifying examinations as prescribed by Government of Karnataka.

vi. Merit list as prepared by Admission Committee shall be submitted to the Chancellor for his/her approval.

vii. The Admission Committee shall notify the list of selected candidates.

viii. The selected candidates (as per the notification) shall complete the admission process by submitting the requisite forms along with supporting documents, paying the prescribed fees and full filling any other requirements mentioned in the notification.

ix. Candidates who have passed a qualifying examination not conducted by Government of Karnataka or this University shall submit the eligibility and migration certificate in original for admission to a programme of study.

x. Candidate shall be required to submit medical certificate and character certificate from the recognized Doctor and Head of the institution last attended respectively.

xi. Admission to II$^{nd}$ year/ III Sem B.E./B.Tech. under lateral entry scheme shall be open to the candidates who have passed the three year diploma from the Karnataka state and secured not less than 45% of marks in aggregate (considering the marks of all six semesters). In case of SC/ST and OBC students from Karnataka state the eligibility shall be 40%. However candidates who have passed diploma from other than the Karnataka state shall provide the equivalence/ eligibility certificate from the director of technical education, Bangalore. Also, the students who have passed B.Sc. Degree from the recognized university or equivalent qualification as recognized by university and secured not less than 45% marks in aggregate (considering the marks of all six semesters). In case of SC/ST and OBC students from Karnataka state the eligibility shall be 40% However candidates who have passed B.Sc. from other than the Karnataka state shall provide the equivalence/ eligibility certificate from the competent authority.

**6 A. MANDATORY INDUCTION PROGRAMME:**

**All the new entrants to the university shall attend Mandatory Induction Programme for duration of 3 weeks.**

**7. ATTENDANCE REQUIREMENT:**

i. Each semester is considered as one unit and the student is required to have a minimum attendance of 85% in each course with a provision of condonation of 10% of attendance by the Vice- Chancellor on the specific recommendation of the Dean of the Faculty, indicating reasonable cause such as medical ground participation in University level sports, cultural programs, seminars, workshops, paper presentation, etc.

ii. The calculation of the attendance shall be based on the reopening date notified by the University by its calendar of events from time to time. However, for first semester (III semester for later entry) students the same will be reckoned from the date of admission to the course as per KEA CET/the University allotment.

iii. The shortage of attendance shall be informed to the students/Parents by the Dean/Chairman/Coordinator/Teacher concerned periodically to be cautious and to make up the shortage. In case, a student's class attendance in a course is less than as stipulated by the University, the student is said to have dropped that course and the student has to re-register for the dropped course when the course is offered again by the Department if it is a hard core course. The student may choose the same or any alternate core/elective in case the dropped course is soft core/elective course.

iv. Provided that mere omission by the University to inform the student about the shortage of attendance shall not entitle him/her to appear for examination.

**8. ASSESSMENT AND EVALUATION:**

The assessment and evaluation of each student shall comprise of two components viz; Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Equal weightage shall be given for CIE and SEE.

**8.1. Continuous Internal Evaluation:**

The CIE shall be conducted by the course teacher throughout the semester. The suggested components of CIE for Theory and Laboratory/ Project course are as depicted below in Table-I and Table-II respectively.

**Table-I: Suggested components of CIE for Theory**

| Sl. No | Components | Marks |
|---|---|---|
| 1 | Internal Test-I* | 15 |
| 2 | Internal Test-II* | 15 |

| | | |
|---|---|---|
| 3 | Internal Test-III* | 15 |
| 4 | Daily/Regular/ Session wise Seminar/Assignment/Mock Evaluation | 35 |

*Average of Best Two performances of the Internal Tests shall be considered for 15 Marks.

**Table-II: Suggested components of CIE for Laboratory/Project**

| **Sl. No** | **Components** | **Marks** |
|---|---|---|
| 1 | Conduction of experiments / Design and fabrication of the system/ Project. | 25 |
| 2 | Evaluation of Lab/project report | 15 |
| 3 | Mock Evaluation/ Presentation | 10 |

The suggested components of CIE for Seminar, Internship and Final Project course are as depicted below in Table-III, Table-IV and Table-V respectively.

**Table-III: Suggested components of CIE for Seminar**

| **Sl. No** | **Components** | **Marks** |
|---|---|---|
| 1 | Identification of Seminar topic from referred Journals in relevant domain suggested by the guide | 20 |
| 2 | Report on Seminar and Evaluation | 40 |
| 3 | Presentation | 40 |

**Table-IV: Suggested components of CIE for Internship**

| Sl. No | Components | Marks |
|---|---|---|
| 1 | Midterm Presentation on Internship | 25 |
| 2 | Report on Internship | 25 |

**Table-V: Suggested components of CIE for Final Project**

| Sl. No | Components | Marks |
|---|---|---|
| 1 | Project Phase-I<br>Literature Survey / Visit to industries / R & D to finalize the project topic | 50 |
| 2 | Project Phase-II<br>a) Design, Testing and Results analysis<br>b) Presentation<br>c) Thesis Writing | 30<br>10<br>10 |

**8.1.1 Provision to Drop the Course:**

In case a student secures less percentage of marks as prescribed in the course, the student is said to have **dropped** that course, and such a student is not allowed to write SEE in that course**.**

A student has to re-register for the **dropped** course when the course is offered again by the department if it is a hard core course. The student may choose the same or an alternate core/elective, in case the dropped course is soft core/elective course.

A student who is said to have dropped the Internship/project work has to re-register for the same subsequently within the stipulated period.

**The details of any dropped course shall not appear in the Grade card.**

**8.1.2 Provision to withdraw course:**

A student can withdraw any course within 10 days from the date of commencement of semester. Whenever a student withdraw a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective.

**8.1.3 Provision for Appeal:**

If a student is not satisfied with the evaluation of CIE, he/she can approach the Grievance

Reddressal Cell with the written submission together with all the facts, the assignments, test papers etc which were evaluated. This shall be done before the commencement of SEE. The Grievance Reddressal Cell shall look into the details and if necessary take corrective measures.

**8.2. Semester End Examination (SEE):**

i. A student, who has complied with the minimum specified attendance in a programme and secured greater than or equal to 50% in CIE, shall register for SEE by paying the prescribed fees. The registration process may be online/offline as notified from time to time by the Registrar Evaluation. The registration of a student shall be liable to be cancelled by the office of the Registrar Evaluation, where disciplinary issues are raised by the concerned Dean of Faculty.

ii. After the last date of registration for SEE, the list of students along with their registered courses shall be released by the office of Registrar Evaluation. A student shall verify the accuracy of his/her particulars in the list and discrepancies, if any, shall be reported to office of Registrar Evaluation within Three days from the date of release.

iii. The office of the Registrar Evaluation shall issue the Admit cards to eligible students based on the SEE list. The Admit card of a student shall be valid only for the SEE for which it is issued. The Admit card of a student shall include (i) recent photograph of the student and (ii) registered courses for SEE with subject codes.

iv. With the specific approval of the Vice-Chancellor/the Chancellor, under extra ordinary circumstances, a student whose name does not find place in the student list may be permitted to appear for SEE. The result of such a student may be announced after due verification.

v. The Registrar Evaluation shall appoint Chief Superintendent and Deputy Chief Superintendent for the conduct of SEE as per the Time Table notified.

**Theory Examination:** The SEE shall be of three hours duration or as mentioned in the scheme. The evaluation for this component shall be 50% of the maximum marks.

**Laboratory Examination:** The SEE shall be of three hours duration or as mentioned in the scheme and shall comprise of Conduction of experiments / Design and fabrication of the system/ Project. The evaluation for this component shall be 50% of the maximum marks.
The SEE for Laboratory shall be held in batches over several days. There shall be one Internal and one External Examiner and the evaluation shall be based on experimental procedure, write up, coding, execuation, Demonstration, Result analysis / Graphs if any and Viva-voce.

**Project Examination:** The SEE for the Project shall be evaluated by two examiners jointly and the evaluation shall be based on various components such as, Writing of Abstract, Project report, Oral Presentation, Demonstration and Viva-voce.
**Note:** The distribution of marks for various components shall be made available to the Examiners by the Registrar Evaluation from time to time.

**Question paper pattern:** The question paper for theory courses consist of Five modules. In each module, there are two full questions. The Students are required to answer five full questions selecting one from each module.
**Note**: Some courses which include design, drawing and mandatory courses shall have their own pattern.

**Valuation of Answer Scripts:**

The Registrar Evaluation shall appoint Chief Coordinator and Deputy Chief Coordinator for the evaluation of SEE answer scripts.

The Registrar Evaluation shall notify the guidelines for the evaluation of various subjects.

The answer books of SEE may be coded before issuing for evaluation by the office of the Registrar Evaluation.

## 9. ELIGIBILITY FOR PASSING:

The CIE and SEE have equal weightage and the student performance is judged by taking into accounts the results of CIE and SEE individually and also combined. The passing standards are as depicted in the Table-VI.

**Table-VI. Eligibility for passing.**

| | **Eligibility for passing.** |
|---|---|
| **CIE** | ≥ 50% of Maximum marks |
| **SEE** | ≥ 40% of Maximum marks |
| **CIE + SEE** | ≥ 45% of Maximum marks taken together |

The student who passes a course of a semester shall not be allowed to appear for the same again, unless he/she opts for rejection of results as per the following:

i. A student may, at his/her desire, reject his/her total performance of SEE (including CIE marks) or he/she may reject the performance of SEE only. The rejection is permitted only once during the entire course of study.

ii. The student who desires to reject the performance as per (i) shall reject performance in all the courses of that semester, irrespective of whether the student has passed or failed in any course. However, the rejection of performance of $4^{th}$ year project work shall not be permitted.

iii. A student who desires to reject the total performance of the semester (including CIE), has to take readmission for the relevant semester. Application for such readmission shall be sent to the Registrar through the Dean of faculty within 30 days from the date of announcement of the results. Late submission of application shall not be accepted for any reasons. Readmission to First semester in such cases shall not be considered as Fresh admission.

iv. The student, who desires to reject only the results of SEE of a semester and does not desire readmission, shall be permitted to re-appear for examinations of all the courses of the semester in the subsequent examinations. However, the CIE marks obtained by the student in the rejected semester shall be retained. Application for such readmission shall be sent to the Registrar through the Dean of faculty within 30 days from the date of announcement of the results as per the admission notification issued by the University from time to time. Late submission of application shall not be accepted for any reasons.

**Grace Marks:** Grace marks shall be awarded to the students in SEE for passing theory/ Laboratory and / or passing semester as per the following attributes:

i. Grace marks shall be awarded to theory / laboratory to a maximum of 2% of total SEE marks, if and only if the student clears that theory / laboratory with minimum prescribed marks.

ii. If a student failed in any one theory / laboratory, he/she is eligible for 3 grace marks, if and only if he/she passes the semester.

A student is granted either i or ii of the above, not both. The granted marks shall be documented in the records but not disclosed in the grade card.

**Make Up Examination:**

The Make Up examination shall be available to students who may have missed to attend the SEE of one or more courses in a semester for valid reasons and given the 'I' grade. The students having 'X' grade shall also be eligible to take up Make Up examination. The Make Up examinations shall be held as per dates notified in the Academic Calendar by notification from time to time. The standard of the Make Up examination shall be same as that of regular SEE for the courses.

## 10. ELIGIBILITY REQUIREMENTS FOR PROMOTION TO NEXT ACADEMIC YEAR:

i. There shall not be any restrictions for promoting from an ODD semester to the next EVEN semester, provided that, the student has fulfilled the attendance requirement.

ii. For vertical promotion in order to move from one academic year to next academic year i.e., from EVEN to ODD semester, a student can carry a maximum of five heads as 'F' grades not exceeding a maximum of 16 credits and he/she should maintain a CGPA of 4.

iii. A student who has not obtained the eligibility even after **two/three/four** academic years for a programme of **three/ four / five** years respectively, from the date of admission to first semester **shall discontinue the programme or get readmitted** to first semester as a fresh admission.

iv. The mandatory non credit courses Additional mathematics I & II prescribed at 3rd & 4th semester respectively to lateral entry diploma holders admitted to 3rd semester of B.Tech programs, shall attend the classes during respective semester to complete CIE and attendance requirements and to appear SEE examination. In case any student fail to satisfy the course requirements he / she shall be deemed to have secure F grade. In such case, the student have to fulfill the requirements during subsequent semester/s to appear for SEE.

**v. Completion of Additional Mathematics I and II, shall be mandatory for the award of B.Tech. degree.**

vi. Lateral entry students with **B.Sc degree** shall clear non credit courses such as Engineering Graphics, Elements of Civil Engineering etc. or as decided by BOS from time to time of the first year engineering programme for the award of degree.

**vii. Completion of mandatory non credit courses (as mentioned in vi) shall be mandatory for the award of B.Tech. degree**

## 11. MAXIMUM DURATION FOR UG PROGRAM COMPLETION:

The student shall complete the UG program of **Three/Four/Five** years within a maximum period of **Six/Eight/Ten** Academic years from the date of first admission, failing which he/she shall be declared as **Not Fit for Professional Education.**

## 12. TYPES OF COURSES:

The curriculum shall be designed based on the concept of **Outcome Based Education**.

The **CBCS** provides choice for the students, to select from the prescribed courses of the programme of study.

i. Different Courses to be offered in a programme of study shall be categorized into the following **SIX** types:

ii. **Humanities and Social Sciences (HSS):** These courses enable the students to acquire the required skills and knowledge essential to pursue a given programme of study. These courses include communication, economics, environment, professional ethics, constitution of India etc;. These courses shall be in the range of 3-6% of the total minimum credits for a programme of study.

iii. **Foundation Courses (Exclusively for Faculty of Engineering & Technology):** Foundation Courses are categorized in to Two parts, (1) Basic Sciences (BS) and (2) Engineering Sciences (ES).

**BS** courses includes, physics, chemistry, maths, statistics and they are mandatory for all the engineering programme of study.

**ES** Courses includes, elements of: civil, mechanical, electrical, electronic, engineering and computer programming skills, etc; and they are mandatory for all the engineering programme of study.

These courses shall be in the range of 25-30% of the total minimum credits for a programme of study.

iv. **Core Courses:** Core Courses constitute the core of the programme of the study. The core courses of study are of Two types, VIZ; **(1) Hard Core Course (HCC) and (2) Soft Core Course (SCC).**

**Hard Core Course(HCC):** The Hard Core Course is a core course in the main programme of study and the students have to study compulsorily. These courses shall be in the range of 25-30% of the total minimum credits for a programme of study.

**Soft Core Course(SCC):** A core course may be soft core if there is a choice for the student to choose a course from the programme of study or from a sister/ related programme of study which supports the main programme of study. These courses shall be in the range of 2-3% of the total minimum credits for a programme of study.

v. **Elective Courses (EC):**

**Core Elective Courses(CEC):** Elective course is a course, which can be chosen from a pool of courses, and which may be very specific or specialized or advanced or supportive to the programme of study or which provides an extended scope or which enables an exposure to some other programme of study or nurtures the students proficiency . Elective courses may be offered by the main programme of study/ related programme of study/sister programme of study, which supports the main programme of study. These courses shall be in the range of 10-20% of the total minimum credits for a programme of study.

**Open Elective Course (OEC):** An elective course chosen generally from the other programme of study, with an intention to seek exposure is called an **open elective course.** These courses shall be in the range of 1-2% of the total minimum credits for a programme of study.

**Self-Study Elective Course (SEC):** An elective course designed to acquire an advanced knowledge to support a mini project work or major project work, and a student studies such a course on his own with an advisory support by a teacher is called a **self-study elective course.** These courses shall be in the range of 5-7% of the total minimum credits for a programme of study.

vi. **Audit Courses(AC):** A student may be permitted to take any number of audit courses over and above the graduation requirements for learning a subject.

vii. **Internship, Research or Seminar and Project Work (PW):** These are intended to enhance the student's practical knowledge and exposure to research and industry. The credits for this category shall not exceed 10-12% of the total minimum credits for a programme. Major project work shall normally be carried out in regular semesters.

**Internship:** The student of UG Programme shall undergo Internship of 8 weeks, preferably, before the commencement of final academic year, whereas for PG Programme they shall undergo Internship of 16 weeks, preferably, at the beginning of third semester.

**Project work:** For UG programme, a batch of students not more than **four** , shall undertake the innovative project ,preferably, in the final semester and execute in the same semester. For PG programme, project work shall be executed individually by the student in the final semester.

**Seminar:** Each student shall chose seminar topic on the emerging area only.

viii. **C**ertain programmes of study may have additional requirements such as apprenticeship and residency.

ix. An additional non-credit **summer project** of three weeks duration after the end of every academic year (preferably in the month of August) shall be carried out by all the students.

**x. Completion of all summer projects shall be mandatory for the award of B.Tech. degree.**

## 13. GRADING PATTERN:

i. The **SHARNBASVA UNIVERSITY** adopts absolute grading system wherein the marks are converted to grades and every *semeste*r results shall be given with ***Semester Grade Point Average* (SGPA)** and ***Cumulative Grade Point Average (CGPA).***

ii. The Grading pattern shall have the letter grade points, as per the following table:

**Table –VII. Grades and Grade Points**

| Level | Outstanding | Excellent | Very Good | Good | Above Average | Average | Poor | Fail |
|---|---|---|---|---|---|---|---|---|
| Letter Grade | O | S | A | B | C | D | E | F |
| Grade Points | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 00 |

iii. A student shall be awarded Grade F if he/she either fails in the course or is absent for the SEE of that course and the student shall be required to reappear for the semester end examination. If the course is laboratory/practical component, the student shall re-appear both CIE and SEE. Absenting in any one or both of them shall result in award of F Grade.

**Table-VIII. Grade Point Scale**

| Level | Outstanding | Excellent | Very Good | Good | Above Average | Average | Poor | Fail |
|---|---|---|---|---|---|---|---|---|
| Letter Grade | O | S | A | B | C | D | E | F |
| Grade Points | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 00 |
| Score (marks) Range (%) | >=90 | <90 >=80 | <80 >=70 | <70 >=60 | <60 >=55 | <55 >=50 | <50 >=45 | <45 |

iv. **W , X and I Grades:**

**W Grade** shall be awarded to a student who has withdrawn from a course. Further, this grade shall be recorded in the grade card. If the course is audit course, then there shall be no mention of course in the grade card.

**X Grade** shall be awarded to a student whose attendance is satisfactory and CIE rating (≥ 60%) in a course, but SEE performance observed to be Poor, for such course X grade shall be awarded. The student shall be provided with an opportunity in the Make-Up examination; however the grades ('B' to 'O') will be reduced to the next lower grade and the other grades remains same.

**I Grade** shall be awarded temporarily to a student who is unable to appear for **SEE** for one or more courses, with the permission of the Vice-Chancellor in response to a written appeal by the student, due to valid reasons such as medical emergency, calamity in the family or any other valid reason. For such a student, the I grade shall be converted in to one of the other letter grades as in the table after the completion of scheduled make up SEE. If the student does not appear to the make-up SEE, the I grade shall be converted to an F grade.

v. **AP and AF Grades:** A student shall be awarded either an **Audit Pass (AP) or Audit Fail (AF)** grade for an audit course. The Audit Pass *(AP*) grade shall be awarded if the student satisfies the attendance and performance criteria specified for the course by the concerned Faculty. Otherwise, an *AF* grade shall be awarded.

vi. **COMPUTATION OF SGPA and CGPA:**

**COMPUTATION OF SGPA:**

**Illustration of Computation of SGPA and Format for Transcripts**

**Computation of SGPA**

**Illustration No. 1**

| **Course** | **Credit (C)** | **Letter Grade** | **Grade point (G)** | **Credit point (C X G)** |
|---|---|---|---|---|
| **Course 1** | **4** | **A** | **8** | **4X8=32** |

| | | | | |
|---|---|---|---|---|
| **Course 2** | **4** | **C** | **6** | **4X6=24** |
| **Course 3** | **4** | **B** | **7** | **4X7=28** |
| **Course 4** | **3** | **O** | **10** | **3X10=30** |
| **Course 5** | **3** | **D** | **5** | **3X5=15** |
| **Course 6** | **1** | **C** | **6** | **1X6=06** |
| **Course 7** | **1** | **S** | **9** | **1X9=09** |
| **Course 8** | **1** | **C** | **6** | **1X6=06** |
| | **21** | | | **150** |

**Thus. SGPA=150/21 =7.14**

**Illustration No. 2**

| **Course** | **Credit (C)** | **Letter Grade** | **Grade point (G)** | **Credit point (C X G)** |
|---|---|---|---|---|
| **Course 1** | **4** | **A** | **8** | **4X8=32** |
| **Course 2** | **4** | **C** | **6** | **4X6=24** |
| **Course 3** | **4** | **B** | **7** | **4X7=28** |
| **Course 4** | **3** | **O** | **10** | **3X10=30** |
| **Course 5** | **3** | **F** | **0** | **3X0=0** |
| **Course 6** | **1** | **C** | **6** | **1X6=06** |
| **Course 7** | **1** | **S** | **9** | **1X9=09** |
| **Course 8** | **1** | **C** | **6** | **1X6=06** |
| | **21** | | | **135** |

**Thus. SGPA=135/21= 6.43**

**Illustration No. 2(A)**

| **Course** | **Credit (C)** | **Letter Grade** | **Grade point (G)** | **Credit point (C X G)** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Course 5** | **3** | **B** | **7** | **3X7=21** |
| | **21** | | | **(First Attempt=135+Subsequent Attempt =21 )=156** |

**Thus. SGPA=156/21= 7.43**

**Illustration No. 3**

| **Course** | **Credit (C)** | **Letter Grade** | **Grade point (G)** | **Credit point (C X G)** |
|---|---|---|---|---|
| **Course 1** | **4** | **A** | **8** | **4X8=32** |
| **Course 2** | **4** | **C** | **6** | **4X6=24** |
| **Course 3** | **4** | **B** | **7** | **4X7=28** |
| **Course 4** | **3** | **O** | **10** | **3X10=30** |
| **Course 5** | **3** | **S** | **9** | **3X9=27** |
| **Course 6** | **1** | **C** | **6** | **1X6=06** |
| **Course 7** | **1** | **S** | **9** | **1X9=09** |
| **Course 8** | **1** | **C** | **6** | **1X6=06** |
| | **21** | | | **162** |

**Thus. SGPA=162/21= 7.71**
**CGPA=(21X7.14+21X7.43)/42 =7.28**
**CGPA after Final Semester**

| **Semester 1** | **Semester 2** | **Semester 3** | **Semester 4** | **Semester 5** | **Semester 6** | **Semester 7** | **Semester 8** |
|---|---|---|---|---|---|---|---|
| **Credit : 21 SGPA: 7** | **Credit : 21 SGPA: 8.5** | **Credit : 21 SGPA: 9.2** | **Credit : 21 SGPA: 6.86** | **Credit : 21 SGPA: 8.18** | **Credit : 21 SGPA: 7.73** | **Credit : 17 SGPA: 8.68** | **Credit : 17 SGPA: 9.4** |

**Thus,**
**CGPA= (21X7+21X8.5+21X9.2+21X6.86+21X8.18+21X7.73+17X8.68+17X9.4)/160**
**= 8.15**

## 14. CONVERSION OF GRADES INTO PERCENTAGE:

Conversion of GPA into Percentage is given below

***Percentage of Marks= (CGPA Earend-0.75)*10***

**CLASS/DIVISION DECLARATION:**

| **Equivalent Percentage** | **Class** |
|---|---|
| **>= 70%** | **First Class with Distinction** |
| **60% <= % < 70%** | **First Class** |
| **50% <= % < 60%** | **Second Class** |
| **45% <= % < 50%** | **Pass Class** |
| **< 45%** | **Fail** |

## 15. AWARD OF PRIZES, MEDALS AND RANKS:

i. For the award of *Prizes* and *Medals*, the conditions stipulated by the Donor shall be considered subject to the provisions of the statutes framed by the University for such awards.

ii. For award of rank in a specialization of B.Tech., the CGPA secured by the student from III to VIII semester is considered, for B.Arch. the CGPA of III to X semester shall be considered, for BCA and BBA all semesters CGPA shall be considered.

iii. A student shall eligible for a rank at the time of award of the degree of B.Tech/BCA/BBA etc, provided the student:

   a. Has passed all semester in all courses in first attempt only in case of candidate admitted to I year.
   b. Has passed III to last semester in all courses in first attempt only in case of candidate admitted under lateral entry scheme.
   c. Has completed all the prescribed Audit/mandatory courses.
   d. Is not repeated in any semester because of rejection of result of a semester/ shortage of attendance etc;.
   e. Has completed all the semester without any break/discontinuity.
   f. Has completed all the semester (I to last semester or III to last semester for lateral entry students) in the University
   g. Has not been transferred from any autonomous institution or from any other University to the Sharnbasva University.

iv. Total number of ranks awarded shall be 10% of the total number of students appeared in final semester subject to the maximum of 10 ranks in a specialization.

v. For award the rank in specialization, a minimum of 10 students should have appeared in the final semester examination.

**Illustration.**

a. If 1228 students appeared for the VIII semester in Electronics and Communication Engineering Programme, the number of ranks to be awarded for Electronics and Communication Engineering shall be 10.
b. If 90 students appeared for the VIII semester in Biomedical Engineering, the number of ranks to be awarded for Biomedical Engineering will be 9.
c. If 10 or less students appeared for the final semester of any degree, the number of ranks shall be awarded is one.

vi. In case of fraction number of ranks, it is rounded to higher integer when the first decimal place value is greater than or equal to 5.

vii. Ranks are awarded based on the merit of the students as determined CGPA. If two or more students get the same CGPA, the tie shall be resolved by considering the number of times student has obtained higher SGPA. If it is not resolved even at this stage, the number of times student has obtained higher grades like S, A, B, etc., shall be taken into account to decide the order of the rank.

**16. APPLICABILITY AND POWER TO MODIFY:**

i. The regulations governing the degree of Bachelor of Engineering / Technology of SUK shall be binding on all concerened.

ii. Not withstanding any thing contained in the foregoing the university shall have the power to issue directions /orders to address any difficulty.

iii. Nothing in the foregoing may be construed as limiting the power of the University to amend, modify or repeal any or all of the above.

## NEW GUIDELINES FOR TEACHING/LEARNING AND CONDUCT OF EXAMINATIONS

The present situation demands tech-mediated education system, hence new guidelines for teaching/learning and conduct of examinations have been amended for sustainable long-term-shift in education policy.

Following are the new guidelines:

**A. TECHNOLOGY MEDIATED TEACHING LEARNING PROCESS:**

1. Online learning:

- It’s not video lectures and e-books that convert class notes into PDF.
- Creating high quality digitized learning content which makes learners interesting and engaging.

2. Subject matter covered in class room is to be delivered online. It shall not be blind replication of the same.
3. Diverse learner groups:
   To handle diverse learner groups, it is easy to use classrooms teaching/learning rather than online.
   However, institution has to spend more time on the context for the diverse learner profiles as on the content and weave it into program design.
4. Create customized learning plans and methods by using newer technologies like, AI and top learning methods.
5. After each learning modules the student will be able to apply the required knowledge in practical situations in the life profession workplace. Each faculty shall be massively trained for online T/L mode. Even though they are great classroom teachers they need to place equal importance to learning science in digital mode.
6. Even in situations like post COVID-19 era, conventional education mode will not become absolute. Therefore hybrid learning (a combination of classroom and online modes) will be the norm.
   Institutions and faculties will blend the two judiciously to the context and the content.
   To adopt the online module successfully in education following transformation is must:
   - Faculty should adopt change from classroom to online mode.
   - Universities shall come forward to collaborate with digital learning specialities to train their faculties and re-design higher education for the newer online education world.

**B. EXAMINATION RELATED GUIDELINES:**

1. MCQ/OMR based CIE test and Semester End Examinations.
2. Open Book Examination.
3. Open Choices, Assignments/Presentation based Assessments.
4. Examination period may be reduced from 3 hrs to 2 hrs, without compromising the quality of Questions and Evaluation procedure.
5. Presently, we are evaluating the students performance based CIE and SEE giving 50% weightage for both. In case, the situation arises like this, and if the performance of the students is known in CIE, then it shall be considered as 100%.
   - In case, if the students are not assessed in both CIE and SEE, then the performance of the previous year shall used to promote to the higher semester or carry forward method should be employed.
   - If student wish to improve the grade they have to write the examination during the next semester as special case.

**C. ATTENDANCE:**

Existing attendance guidelines may be followed. In case situations like COVID-19, then the lock period may be treated as deemed to be attended.

**Sharnbasva University, Kalaburagi**

Scheme of Teaching and Examination 2021-22

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2021-22)

III SEMESTER B.Tech (ME)

| si.No | Category | Course Code | Course Title | Teaching Dept.& Paper Setting Board | Teaching Hours/week | | | | Examination | | | | credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Total contact hours | Duration in hours | CIE Marks | **SEE Marks** | Total Marks | |
| 1 | BSC | 21MAT31 | Engineering Mathematics-III | Mathematics | 3 | 01 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 2 | PCC | 21ME32 | Basic Thermodynamics | ME | 3 | 01 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 3 | PCC | 21ME33 | Manufacturing Process | ME | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 4 | PCC | 21ME34 | Material Science | ME | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 5 | ESC | 21MEL35 | Computer aided machine drawing Lab | ME | 01 | | 04 | 05 | 3 | 50 | 50 | 100 | 03 |
| 6 | PCC | 21MEL36 | Material science Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 7 | PCC | 21MEL37 | Work shop practiceLab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 8 | MP | 21MEMP38 | Project-III | ME | | | 2 | 02 | 2 | 50 | 50 | 100 | 01 |
| 9 | HSMC | 20KANAK310/21KANKK310 | KANNADA KALI / Ayda Kategalu | | 1 | | | 01 | 2 | 50 | 50 | 100 | 01 |
| **Total** | | | | | **14** | **02** | **10** | **26** | **25** | **450** | **450** | **900** | **21** |

Category BSC-Basic Science Course , ESC- Engineering Science Course, PCC-Professional Core, HSMC-Humanity and Social Science Cource, MP-Mini Project,

# ENGINEERING MATHEMATICS-III

**(Common to all branches)**

**[As per Choice Based Credit System (CBCS) scheme]**

**(Effective from the academic year 2019-20)**

**Course Code : 21MAT31** | **CIE Marks : 50**
**Contact Hours/Week : 04** | **SEE Marks: 50**
**Total Hours:50** | **Exam Hours:03**
**Semester : III** | **Credits: 04**

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**Course Learning Objectives:**

This course will enable students to:

- Introduce most commonly used analytical and numerical methods in the different engineering fields.
- Learn Laplace transform and Z-transforms, statistical methods, numerical methods.
- Solve the problem on Interpolation.
- To discuss the random variable and associated probability distributions.

## MODULE-I

**LAPLACE TRANSFORMS :** Definition, Laplace transforms of Elementary functions, properties(without proof) periodic function, Unit step function, Unit impulse function.

**INVERSE LAPLACE TRANSFORMS :** Definition, Convolution Theorem(without proof), Finding Inverse Laplace transform by convolution Theorem. Solution of Linear Differential equations using Laplace Transforms and Applications(5 Assignment Problem).

**10 - Hours**

## MODULE-II

Z- **TRANSFORMS:** Difference Equations ,Basic definitions, Damping rule, Shifting rule, Initial and Final Value theorems(without proof) and problems.

Inverse Z-transforms. Applications of Z-transforms to solve difference equation(5 Assignment Problem).

**10 - Hours**

## MODULE-III

**STATISTICAL METHODS:** Correlation-karl Pearson's co-efficient of correlation problems. Regression analysis lines of regression (without proof)-problems.

**CURVE FITTING:** Curve fitting by the method of least square. Fitting of the curves of the form $y = ax + b, y = ax^2 + bx + c$ & $y = ae^{bx}$.

**Numerical Methods:** Numerical solution of algebraic and transcendental equations by Regula - Falsi Method and Newton-Raphson method. (5 Assignment Problem).

**10 - Hours**

## MODULE-IV

**FINITE DIFFERENCE:** Forward and Backward differences, Newton's forward and backward interpolation formulae. Divided difference-Newton's divided difference formulae. Lagrange's-interpolation formula and inverse interpolation formula(all formula without proof) problems.

**NUMERICAL INTEGRATION:** Simpsons$(\frac{1}{3})^{rd}$, $(\frac{3}{8})^{th}$ rules, Weddle's rule (without proof) problems. (5 Assignment Problem).

**10 - Hours**

## MODULE-V

**Probability Distribution:** Random variables(discrete and continuous) probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and Normal distributions. Problems. (5 Assignment Problem).

**10 - Hours**

**Course outcomes:** On completion of this course, students are able to:

- Know the use of Laplace transform and inverse Laplace transform in signal and image processing.
- Explain the general linear system theory for continuous time signals and digital signal processing using Z-transform.
- Employ appropriate numerical methods to solve algebraic and transcendental equations .
- Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applica tion in the field of electro-magnetic and gravitational fields and fluid flow problems.

**Question paper pattern:**

- The question paper will have ten questions.
- Each full Question consisting of 16 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

*1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*
*2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons,10th Ed., 2015.*

**Reference Books:**

*1. N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers , 7th Ed., 2010.*
*2. B.V.Ramana: "Higher Engineering Mathematics" Tata McGraw-Hill, 2006.*
*3. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S. Chand publishing, 1st edition, 2011.*

**Web Link and Video Lectures:**

1. *http://nptel.ac.in/courses.php?disciplineID=111*
2. *http://www.khanacademy.org/*
3. http://www.class-central.com/subject/math

## BASIC THERMODYNAMICS

**Semester: III**

| Course | Code | Credits | Total Hours - 50 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Basic Thermodynamics | 21ME32 | 04 | 03 | 01 | 50 | 50 | 03 |

### COURSE OBJECTIVES

1. Learn about thermodynamic systems and boundaries
2. Study the basic laws of thermodynamics including, conservation of mass, conservation of energy or first law , second law and Zero$^{th}$ law.
3. Understand various forms of energy including heat transfer and work.
4. Analyze displacement work for a part of system boundary & whole system
5. Identify various types of properties (e.g., extensive and intensive properties)
6. Use tables, equations, and charts, in evaluation of thermodynamic properties
7. Apply conservation of mass, first law, and second law in thermodynamic analysis of systems (e.g., turbines, pumps, compressors, heat exchangers, etc.)
8. Enhance their problem solving skills in thermal engineering

**Module-1** Fundamental Concepts , Definitions , Work and Heat (10 hours)

Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems. Thermodynamic systems and control volume with examples. Thermodynamic properties, states, processes and cycles, reversible and irreversible process, quasi-static process. Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zero$^{th}$ law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature, simple problems on temperature concept.

Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention, Point and path function. Displacement work in quasi static process, other modes of work , Heat Transfer and Compression of heat and work.

**Module-2** First Law of Thermodynamics (10 hours)

Joules experiments, equivalence of heat and work, Statement of the First law of thermodynamics, energy as a property, modes of energy, Different forms of stored energy, Corrollaries of first law, Specific heat at constant volume and constant pressure, application of first law to a closed system (Non Cyclic Processes), Steady and Unsteady flow process, Steady Flow Energy Equation (SFEE), Application of steady flow energy equation - work absorbing system, work developing system and non work absorbing and non work developing systems, related numerical problems.

**Module-3** 2nd law of Thermodynamic (10 hours)

Introduction and limitation of First law, Heat engine, Heat pump and Reversed Heat Engine, Energy Reservoirs kelvin – plank statement of second law, clausius statement of second law, Equivalence of the two statements, Perpetual motion machine of second kind, Reversibility and Irreverssibility Processes, Carnot cycle, Numerical Problems.

**Module-4 Entropy** (10 hours)

Entropy and its Defination, two reversible adiabatic lines cannot intersect each other, Clausius theorm and Clausius inequality, Entropy is a point function, T- S Diagram, principle of increase in entropy, Application of Entropy Principal, Entropy using Tds relation, Entropy Change for Ideal gas and numerical problems.

**Module-5** pure substance , available and irreversibility, Ideal gases and real gases (10 hours)

Introduction, P-T-V of a pure substance, P-T Diagram, triple point and critical points, Enthalpy of steam, Latent heat, External work done, Internal energy of a system, state changes of system involving a pure system, dryness fraction, saturated vapors, two phase mixture, vapour phase, steam table, formation of steam at constant pressure, Measurement of dryness fraction of steam, Throttling calorimeter, separating and throttling calorimeter and numerical problems.

Defination, Daltons law of partial pressures, Amagat's law of additive volumes, Internal energy and specific heats of an ideal gas mixture, enthalpy of ideal gass mixture, entropy of ideal gass mixture, Van-der Waal's Equation of state, Van-der Waal\'s constants in terms of critical properties, Beattie-Bridgeman equation, compressibility factor; compressibility chart. Difference between Ideal and real gases.

**COURSE OUTCOMES:** The student will be able to

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Explain thermodynamic systems, properties, Zero$^{th}$ law of thermodynamics, temperature scales and energy interactions. | U |
| CO2 | Determine heat, work, internal energy, enthalpy for flow &non flow process using First Law of Thermodynamics. | Ap |
| CO3 | Determine heat, work, internal energy, enthalpy for flow &non flow process using Second Law of Thermodynamics. | U |
| CO4 | Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases. | Ap |
| CO5 | Interpret behavior of pure substances and its applications to practical problems.Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation and Beattie Bridgeman equation. | Ap |
| | **Total Number Lecture hours** | **50** |

**TEXT BOOKS:**


1. Basic Engineering Thermodynamics, A.Venkatesh, Universities Press, 2008
2. Basic thermodynamic , R K Hegde, Sapna publication.
3. Basic and Applied Thermodynamics, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002


**REFERENCE BOOKS:**


1. Thermal Engineering , Dr C P Kothandaraman, Dhanpat rai & CO (P) LTD, Eductional & Techinical Publishers
2. Thermal Engineering, R K Rajput, Laxmi Publication LTD
3. Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2002
4. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons.
5. An Introduction to Thermodynamcis, Y.V.C.Rao, Wiley Eastern, 1993,
6. B.K Venkanna, Swati B. Wadavadagi "Basic Thermodynamics, PHI, New Delhi, 2010


**DATA HANDBOOKS:**


1. D1. Thermodynamic data hand book, B.T. Nijaguna.
2. D2. Properties of Refrigerant & Psychometric (tables & Charts in SI Units),Dr. S.S. Banwait, Dr. S.C. Laroiya, Birla Pub. Pvt. Ltd., Delhi, 2008.
3. D3. Thermodynamic data hand book R K Hegde.
4. D4. Thermodynamic data hand book R S Khrumi.


**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

## MANUFACTURING PROCESS

**Semester: III**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Manufacturing Process | 21ME33 | 03 | 03 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To provide detailed information about the molding processes and knowledge of various casting process in manufacturing.
2. To impart knowledge of various joining process used in manufacturing and build adequate knowledge of quality test methods conducted on welded and casted components.

**Module-1 Introduction& basic materials used in foundry(10 hours)**

**Introduction:** Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved. Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

**Sand molding:** Types of base sand, requirement of base sand. Binder, Additives definition, need and types.

**Preparation of sand molds:** Molding machines- Jolt type, squeeze type and Sand slinger. Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mold, shell mold, investment mold, plaster mold, cement bonded mold. Cores: Definition, need, types. Method of making cores, concept of gating (top, bottom, parting line, horn gate) and rise ring (open, blind) Functions and types.

**Module-2 MELTING & METAL MOLD CASTING METHODS (10 hours)**

**Melting furnaces:** Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace,constructional features & working principle of cupola furnace.

**Casting using metal molds:** Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes.

**MODULE – 3 SOLIDIFICATION & NON FERROUS FOUNDRY PRACTICE(10 hours)**

**Solidification**: Definition, Nucleation, solidification variables, Directional solidification-need and methods. Degasification in liquid metals-Sources of gas, degasification methods.

**Fettling and cleaning of castings:** Basic steps involved. Sand Casting defects- causes, features and remedies. Advantages & limitations of casting process

**Nonferrous foundry practice**: Aluminum castings - Advantages, limitations, melting of aluminum using lift-out type crucible furnace. Hardeners used, drossing, gas absorption, fluxing and flushing, grain refining, pouring temperature. Stir casting set up, procedure, uses, advantages and limitations.

**Module – 4 WELDING PROCESS (10 Hours)**

**Welding process:** Definition, Principles, Classification, Application, Advantages & limitations of welding. Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW).

**Special type of welding:** Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and electron beam welding.

**Module – 5 SOLDERING , BRAZING AND METALLURGICAL ASPECTS IN WELDING (10 Hours)**

Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds& Residual stresses, Concept of electrodes, filler rod and fluxes. Welding defects- Detection, causes & remedy.

**Soldering, brazing, gas welding:** Soldering, Brazing, Gas Welding: Principle, oxy-Acetylene welding, oxy-hydrogen welding, air-acetylene welding, Gas cutting, powder

cutting.

**Inspection methods:** Methods used for inspection of casting and welding. Visual, magnetic particle, fluorescent particle, ultrasonic. Radiography, eddy current, holography methods of inspection.

**COURSE OUTCOMES:**
The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Describe the casting process, preparation of Green, Core, dry sand molds and Sweep, Shell, Investment and plaster molds. Explain the Pattern, Core, Gating, Riser system and Jolt, Squeeze, Sand Slinger Molding Machines | U |
| CO2 | Describing melting furnace, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace,constructional features & working principle of cupola furnace. Explaining metal mold casting process Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. | Ap |
| CO3 | Describing solidification of castings and finishing process of casted parts | Ap |
| CO4 | Describe the Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes used in manufacturing. Explain the Resistance spot, Seam, Butt , Projection, Friction, Explosive, Thermit, Laser and Electron Beam Special type of welding process used in manufacturing. | Ap |
| CO5 | To develop the knowledge of different metal joining processes and to study about the inspection of joints. | Ap |
| | **Total Number Lecture hours** | **50** |

**TEXT BOOKS:**


1. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.
2. "Manufacturing & Technology: Foundry Forming and Welding",P.N.Rao, 3rd Ed., Tata McGraw
3. Machine tools & operations, AnupGoel, Technical publications,2nd edition 2018.
4. Machine tools and operations, Sagar M. Baligidad, Sunsatar publishers,1st edition 2017.
5. Metal cutting and machine tool engineering, Pakirappa, Durga publishing house, 3rd edition 2015-16.
6. Manufacturing process-2, Kestoor Praveen, Suggi publishing,5th edition 2013.


**REFERENCE BOOKS:**

1. “Process and Materials of Manufacturing”, Roy A Lindberg, 4th Ed.PearsonEdu. 2006.
2. “Manufacturing Technology”, SeropeKalpakjian, Steuen. R. Sechmid,Pearson Education Asia, 5th Ed. 2006.
3. “Principles of metal casting”, Rechard W. Heine, Carl R. LoperJr.,Philip C. Rosenthal, Tata McGraw Hill Education Private Limited Ed.1976
4. Fundamental of Machining and Machine Tools, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor& Francis, Third Edition.
5. All about Machine Tools, Heinrich Gerling, New Age International Publishers revised 2nd Edition, 2006
6. Metal cutting principles, Milton C. Shaw, Oxford University Press, Second Edition,2005.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# MATERIAL SCIENCE

**Semester: III**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Material Science | 21ME34 | 03 | 03 | 00 | 50 | 50 | 03 |

**Course objectives:**

1. Exemplify different engineering materials and their metallurgical properties.
2. Interpret different alloy phase diagrams, particularly Iron-Iron Carbide phase diagram.
3. Distinguish different ferrous and non-ferrous metals based on their microstructure.
4. Summarize different properties and applications of ceramics, polymers, composites and advanced materials.

**Module :1 : Basics, Mechanical Behavior, Failure of Materials**

**Structure of Metals:** Simple Cubic, BCC, FCC and HCP Structures, Coordination number, atomic Packing Efficiency, Crystal imperfections – point, line, surface and volume imperfections, Atomic Diffusion: Phenomenon, Fick's laws of diffusion; Factors affecting diffusion.

**Mechanical Behavior**: Concepts of stress and strain: tension test, compression tests, shear and torsion tests, elastic deformation stress–strain behavior, elasticity, elastic properties of materials, plastic deformation: tensile properties, ultimate tensile strength, ductility, resilience, toughness, true stress and strain, and elastic recovery after plastic deformation.

**Module 2: Fracture, Fatigue, Creep and Mechanisms of strengthening in metals**

**Fracture :** Fundamentals of fracture, ductile fracture, brittle fracture, ductile-to-brittle transition

**Fatigue:** Types of fatigue loading with examples, Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing

**Creep:** Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness.

**Mechanisms of strengthening in metals:** Strengthening by grain size reduction, solid-solution strengthening, strain hardening, Recovery, re-crystallization, and grain growth.

**Module 3: Alloys, Phase diagrams and Iron-carbon diagram**

**Alloys:** Concept of formation of alloys, Types of alloys, solid solutions, factors affecting solid solubility (Hume Rothery rules), Binary phase diagrams: Eutectic, and Eutectoid systems, Lever rule.

**Phase Diagrams:** Definitions and basic concepts: solubility limit, phases, microstructure, phase equilibria, one-component (or unary) Phase diagrams.

**Iron carbon system** - The iron–iron carbide ($Fe–Fe_3C$) phase diagram, development of microstructure in iron–carbon alloys, hypoeutectoid alloys, hypereutectoid alloys, nonequilibrium cooling, the influence of other alloying elements.

**Module :4 : Heat treatment, Ferrous and Non-ferrous materials**

**Heat treatment of metals:** Heat treating of metals: Time-Temperature-Transformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Recrystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Martempering, ustempering, Concept of hardenability, Factors affecting it hardenability, surface hardening methods: carburizing, cyaniding, nitriding, flame hardening and induction hardening, Age hardening of luminum-copper alloys and PH steels.

**Ferrous materials:** Properties, Compositions and uses of Grey cast iron, white cast iron, Malleable iron, SG iron and steel.

**Non-ferrous Metals and Alloys**: Structure and properties of copper and its alloys, Aluminum and its alloys, Al-Cu phase diagram, Titanium and its alloys.

**Module 5: Advanced Materials**

**Composite materials:** Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber-reinforced composites, Fundamentals of production of composites, Processes for production of composites.

**Other materials:** Smart materials, shape Memory alloys and nano material properties and applications.

**Course outcomes:**

- Describe the mechanical properties of metals, their alloys and various modes of failure.
- Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
- Explain the processes of heat treatment of various alloys.
- Understand the properties and potentialities of various materials available and material selection procedures.
- Know about composite materials, smart materials, shape memory alloys and Nano materials and their processing as well as applications.

**TEXT BOOKS:**

1. Mechanical Metallurgy/G E Dieter/ Tata McGraw-Hill/1997.
2. Introduction to Physical Metallurgy / Sidney H. Avener/3rd Edition / Tata McGraw – ill/2012.

**REFERENCE BOOKS:**

1. Material Science and Metallurgy for Engineers/ Kodgire V. D / Everest Publishing House/2011.
2. Science of Engineering Materials / B.K. Agarwal/ Tata McGraw –Hill/1988.
3. Materials Science and engineering / William and collister/8th Edition/ Wiley
4. Elements of Material science / V. Rahghavan/**5th** Edition Addison-Wesley Publishing Co.
5. An introduction to material science / W.G.Vinas & H.L. Mancini,/Princeton
6. Material science & material / C.D. Yesudian & D.G.Hassis Samuel/ Scitech/2006.
7. Engineering Materials and Their Applications/R. A Flinn and P K Trojan / Jaico Books/1999.
8. Engineering materials and metallurgy/R.K.Rajput/1st Edition/ S. Chand/2006.
9. Essential of Materials science and engineering/ Donald R. Askeland and. Pradeep P Phule / Cengage Learning/2004.
10. Material Science/K. M. Gupta/Umesh Publications/2014.

# COMPUTER AIDED MACHINE DRAWING

**Semester: III**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| CAMD | 21MEL35 | 03 | 01 | 04 | 50 | 50 | 03 |

**COURSE OBJECTIVES:**

- To introduce students to the basics of standards of engineering drawing related to machine components.
- To enhance students technical skills regarding orthographic views conversion, part modeling and assembly.
- To impart student knowledge of threads forms, fasteners, riveted joints and shaft joints.
- To make student understand the use of limits, fits and tolerances pertaining to machine drawing in industries.
- To help students to gain knowledge about CAD software in drafting, modeling and assembly of machine components.

**MODULE 01:**

**Sections of Solids**: Sections of Pyramids, Prisms, Cubes, Cones and Cylinders resting only on their bases. (No problems on axis inclination, hollow solids and spheres). True shape of the sections.

4 hours.

**Orthographic views**: Conversion of pictorial views into orthographic projections of simple machine parts without section.

4 hours.

**MODULE 02:**

**Thread forms**: Thread terminology, sectional views of threads, ISO Metric (Internal & External), BSW, American Standard thread, Square and Acme thread, 4 hours

**Fasteners:** Hexagonal headed bolt and nut with washer (assembled view), square headed bolt and nut with washer (assembled view).

4 hours

**MODULE 03:**

**Riveted joints:** Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).

5 hours

**Shaft joints:** Cotter joint (socket and spigot), Knuckle joint (pin joint) for two rods 5 hours

**MODULE 04:**

**Limits, Fits and Tolerances**: Introduction, Fundamental tolerances,

Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. 5 hours

**Couplings:** Split muff coupling, protected type flange coupling, Pin (bush) type flexible coupling, Oldham's coupling and Universal coupling (Hook's Joint). 5 hours

**MODULE 05: Assembly Drawings: (Part drawings shall be given)** 14 hours

1. Screw Jack (Bottle type)
2. Plummer block (Pedestal Bearing)
3. Machine vice
4. Lathe square tool post
5. Cross Head (IC engine).

**COURSE OUTCOMES:**

- Student will be able to acquire the knowledge of various standards and specifications about standard machine components.
- Students will be able to make assemblies with help of given part drawing.
- Student will acquire the knowledge of various standards and specifications about standard machine components.
- Student will be able to apply the knowledge of fits and tolerances in industrial applications
- Will get exposure to advanced CAD packages.

**TEXT BOOKS:**

1. 'Machine Drawing', N.D.Bhat & V.M.Panchal, Published by Charotar Publishing House, 1999.
2. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.

**REFERENCE BOOKS**

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.

**SCHEME OF EVALUATION FOR CIE (50 MARKS)**

(a) Class work (Sketching and Computer Aided Machine drawing printouts in A4 sheets): 35Marks.
(b) Internal Assessment test in the same pattern as that of the main examination: 15 marks.

**SCHEME OF SEE EXAMINATION (50 MARKS)**

Student has to solve three questions, pattern of questions are as follows

| Question no | Modules | Marks |
|---|---|---|
| Q1 | Module 01 OR Module 02 | 20 |
| Q2 | Module 03 OR Module 04 | 30 |
| Q3 | Module 5(Assembly) Or Module 5 (Assembly) | 50 |
| | Total | 100 |

NOTE:

1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours.
2. It is desirable to do sketching of all the solutions before computerization.
3. Drawing instruments may be used for sketching.
4. For Q1, and Q2, 2D drafting environment should be used.
5. For assembly 3D part modeling and assembly should be used and extract 2D views.

## MATERIAL SCIENCE LAB

**Semester: III**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Tutorial | Practical | SEE | CIE | |
| Material Science Lab | 21MEL36 | 01 | 00 | 02 | 50 | 50 | 03 |

**Course Objectives:**

1. To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
2. Calculate the various Mechanical properties of materials such as tensile, flexural, compression Strength and Hardness.
3. To learn material failure modes and the different loads causing failure.
4. To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

**PART-A**

1. Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of (a) plain carbon steel, (b) tool steel, (c) gray C.I, (d) SG iron, (e) Brass, (f) Bronze (g) composites.
2. Brinell hardness test on metals
3.Rockwell hardness test on metals
4. Vickers's Hardness test on metals

**PART-B**

1. Tensile, shear and compression tests of metallic and wooden material specimens using Universal Testing Machine.
2. Bending Test on wooden specimen.
3. Torsion Test on steel bar.
4. Izod and Charpy Tests on Mild steel specimen.
5. Fatigue Test (Demonstration only).

**Course outcomes:**

· Acquire experimentation skills in the field of material testing.
· Develop theoretical understanding of the mechanical properties of materials by performing experiments.
· Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
· Apply the knowledge of testing methods in related areas.
· Know how to improve structure/behavior of materials for various industrial applications.

**Scheme of Examination:**

ONE question from part -A: 30 Marks
ONE question from part -B: 50 Marks
Viva -Voice: 20 Marks
Total : 100 Marks

# WORKSHOP PRACTICE LAB

**Semester: III**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Practical | SEE | CIE | |
| Workshop Practice Lab | 21MEL37 | 01 | 00 | 02 | 50 | 50 | 03 |

## Course objectives:

To impart knowledge and skill to use tools, machines, equipment, and measuring instruments. Also Educate students of Safe handling of machines and tools..

**PART-A**

1.Demonstration on use of Hand Tools: V-block, Marking Gauge, Files, Hack Saw, Drills, Taps.Minimum 3 models involving Dove tail joint,Triangular joint and Semicircular joint.

2.Sheet Metal & Soldering Work: Development & Soldering of the models: Tray, Frustum of cone, Prism(Hexagon &Pentagon),Truncated Square Pyramid, Funnel. 10 Hour

**PART-B**

3.Welding: Study of electric arc welding tools &equipments, Models: Butt Joint, Lap Joint, T joint & L-joint. 10 Hour

4 Carpentry: study of carpentry tools, making of models. Pattern making. 10 Hour

5. Knowing Safety procedures and precautions in workshop. 2 Hour

**Course outcomes:**

At the end of the course, the student will be able to:

1. Demonstrate and produce different types of fitting models.
2. Gain knowledge of development of sheet metal models with an understanding of their applications.
3. Perform soldering and welding of different sheet metal & welded joints.
4. Understand the Basics of Workshop practices.

Text book:

**1.**Elements of Workshop Technology:Vol I:Manufacturing Processes, S K Hajra.Choudhury, A K. Hajra Choudhury,15th Edition Reprinted 2013,Media Promoters &Publishers Pvt Ltd., Mumbai.

**Reference Book:**

**1.**A Textbook of Workshop Technology: Manufacturing Processes By R S Khurmi, 16th edition, S. Chand Publishing.

2. Workshop Technology Part 1: volume 1 fifth edition , W. A. J. Chapman, Published January 1st 1972 by Elsevier Science.

**3.**Introduction to Basic Manufacturing Process & Workshop Technology Singh, Rajender, 2nd edition, New age international, Jan,2010.

**Scheme of Examination:**

ONE question from part -A: 30 Marks

ONE question from part -B: 50 Marks

Viva -Voice: 20 Marks

Total : 100 Marks

# MINI PROJECT-III

**Semester: III**

| Course | Code | Credits | Total Hours - 24 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Practical | SEE | CIE | |
| Mini project-III | 21MEMP38 | 01 | 00 | 02 | 50 | 50 | 02 |

**OBJECTIVES:**

To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

**Mini-project work:**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

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# SHARNBASVA UNIVERSITY, KALABURAGI

**Scheme of Teaching and Examination 2021-22**

**Outcome Based Education(OBE) and Choice Based Credit System (CBCS)**

**(Effective from the academic year 2021-22)**

**IV SEMESTER B.Tech (ME)**

| Sl. No | Category | Course Code | Course Title | Teaching Dept. & Paper Setting Board | Teaching Hours/week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total contact hours | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| 1 | BSC | 21MAT41 | Engineering Mathematics-IV | Mathematics | 3 | 01 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 2 | PCC | 21ME42 | Fundamentals of Fluid Mechanics | ME | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 3 | PCC | 21ME43 | Applied Thermodynamics | ME | 3 | 01 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 4 | PCC | 21ME44 | Instrumentation and Metrology | ME | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 5 | PCC | 21MEL45 | Fluid Mechanics Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 6 | PCC | 21MEL46 | Instrumentation and Measurement Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 7 | PCC | 21MEL47 | Foundry and forging Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 8 | MP | 21MEMP48 | Project-IV | ME | | | 2 | 02 | 2 | 50 | 50 | 100 | 01 |
| 9 | AEC | 21AEC49A/21AEC49B | 3D Printing/Nano Materials | ME | 1 | | | 01 | 3 | 50 | 50 | 100 | 01 |
| 10 | HSMC | 21KK46/18MD46 | Kannada Kalli-4 / Mahadasohigallu | Humanities | 1 | | | 01 | 2 | 50 | 50 | 100 | 01 |
| **Total** | | | | | **13** | **02** | **8** | **23** | **25** | **500** | **500** | **1000** | **20** |

Category: BSC-Basic Science, PCC-Professional Core, HSMC-Humanity and Social Science, MP-Mini project, AEC- Ability Enhancement Course

# ENGINEERING MATHEMATICS-IV

**(Common to all branches)**

**[As per Choice Based Credit System (CBCS) scheme]**

**(Effective from the academic year 2018-19)**

**Course Code : 21MAT41** **CIE Marks : 50**
**Contact Hours/Week : 04** **SEE Marks: 50**
**Total Hours:50** **Exam Hours:03**
**Semester : IV** **Credits: 04**

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**Course Learning Objectives:**

This course will enable students to:

- Learn Fourier series and Fourier transforms.
- Conversant with numerical methods to solve ordinary differential equations, complex analysis, joint probability distribution and stochastic processes arising in science and engineering.

## MODULE-I

**Fourier Series**: Periodic functions, Dirichlet's condition, Fourier Series of periodicfunctio ns with period $2\pi$ and with arbitrary period 2c. Fourier series of even and odd fun ctions Half range Fourier Series, practical harmonic analysis(5 Assignment Problem).

**10 - Hours**

## MODULE-II

**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier-transform (5 Assignment Problem).

**Complex line Integrals:** Cauchy's Integration theorem, Cauchy integral formula, Laurent's Series, types of singularities. Residue, Poles, Cauchy's Residue theorem (without proof ) and Problems.

**Transformations:** Bilinear transformations and problems.

**10 - Hours**

## MODULE-III

**Numerical Methods**: Numerical solution of ordinary differential equations of first order andfirst degree, Taylor's series method, modified Euler's-method
Runge Kutta method of fourth order. Milne's and Adams- Bashforth predictor and corrector methods (No derivations of formulae). (5 Assignment Problem).

**10 - Hours**

## MODULE-IV

**Numerical Methods: Numerical solution of second order ordinary differential equations, Runge- Kutta Method and Milne's Method,** Numerical solution of P.D.E: Numerical solution of Heat equation, Wave equation, problems. (5 Assignment Problem).

**10 - Hours**

## MODULE-V

**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.

**Stochastic process:** Stochastic processes, probability vector, stochastic matrices, fixed p

oints, regular stochastic matrices, Markov chains, higher transition probability-simple problems.
(5 Assignment Problem).

**10 - Hours**

**Course Outcomes:** On completion of this course, students are able to:

- Know the use of periodic signals and Fourier series to analyze circuits and system communications.
- Explain the general linear system theory for continuous time signals and digital signal processing using the Fourier Transform.
- Solve first and second order ordinary differential equations arising in flow problems using single step and multistep numerical methods.
- Understand the analyticity, potential fields, residues and poles of complex potentials in field theory and electromagnetic theory.
- Describe bilinear transformation arising in aerofoil theory, fluid flow visualization and image processing.
- Solve problems on probability distributions relating to digital signal processing, information theory and optimization concepts of stability of design and structural engineering.
- Determine joint probability distributions and stochastic matrix connected with the multivariable correlation problems for feasible random events.
- Define transition probability matrix of a Markov chain and solve problems related to discrete parameter random process.

**Question paper pattern:**

- The question paper will have ten questions.
- Each full Question consisting of 20 marks
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

*1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.*
*2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons,10th Ed., 2015.*

**Reference Books:**

*1. N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.*
*2. B.V.Ramana: "Higher Engineering Mathematics" Tata McGraw-Hill, 2006.*
*3. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics", S. Chand publishing, 1st edition, 2011.*

**Web Link and Video Lectures:**

1. *http://nptel.ac.in/courses.php?disciplineID=111*
2. *http://www.khanacademy.org/*
3. *http://www.class-central.com/subject/math*

# FUNDAMENTALS OF FLUID MECHANICS

**Semester: IV**

| Course | Code | Credits | Total Hours - 40 Hours/Week | | Assessment | | Exam Duration in Hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| **Fluid Mechanics** | **21ME42** | **03** | **03** | **00** | **50** | **50** | **03** |

**Course Objectives:**

- To understand the basic principles and fundamental concepts of fluid mechanics.
- To make the students to understand the concept and apply the various laws solving the fluid engineering problems.
- To make the students familiar with measurements and visualisation of fluid flow types, kinematics, dynamics and its analysis.
- To understand the concept flow of liquids through pipes and different sections and the dimensional quantities.

**Course outcomes:**

| | Course Outcomes | Course Level |
|---|---|---|
| C01 | To analyse a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design. | U |
| C02 | To understand fluid properties and their significance, concept of fluid pressure and related measurement devices | Ap |
| C03 | To visualise different types of fluid flow, and compare them based on kinematic flow descriptions. | U |
| C04 | To understand how mass and momentum is conserved based on Bernoulli's & Newton's laws and its applications. | Ap |
| C05 | To understand the concept of laminar and turbulent flows, flow through pipe loses and dimensional quantities. | Ap |
| | Total number of lecture hours | 50 |

Module-1 10 hours

Basics concepts and definitions:Introduction, Properties of fluids-mass density, weight density, specific volume, specificgravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulkmodulus.

Concept of continuum, types of fluids, pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, absolute, gauge, atmospheric and vacuum pressures. Pressure measurement by simple, differential manometers, mechanical gauges and numerical.

Module-2 10 hours

Fluid Statics: Hydrostatic forces on submerged horizontal plane, vertical plane and inclined planeto determine total pressure and centre of pressure in static fluid.Buoyancy, centre of buoyancy, Meta centre and Meta centric heights application in shipping, stability of floating bodies.

***Module-3*** ***10 hours***

Fluid Kinematics: Types of flows -steady, unsteady, uniform, non-uniform, laminar, turbulent,one,two and three dimensional, compressible, incompressible, rotational, irrational, stream lines,path lines, streak lines, velocity components, convective and local acceleration, velocitypotential, stream function, continuity equation in Cartesian co-ordinates.

Types of Motion, Vorticity and Rationality; Comparison of two circular flows, rotation, vorticity andcirculation, Laplace equation in velocity potential and Poisson equation in stream function, flow net and numerical.

***Module-4*** ***10 hours***

Fluid Dynamics: Introduction to conservation of mass equation of motion, Euler's equation of motion, Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem on venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices and limitations and numerical.

Momentum equation for flow systems: Newton's laws and conservation of momentum; choosing a control volume; forces acting on a control volume; the linear momentum equation and its application on force on pipe bend and numerical.

***Module-5*** ***10 hours***

Flow through pipes: Minor losses through pipes. Darcy's and Chezy's equation for loss of head due to friction in pipes. Hydraulic Gradient Line and Total Energy Line.

Laminar flow and viscous effects: Reynolds number, critical Reynolds number, laminar flow through circular pipe-Hagen Poiseille's equation, laminar flow between parallel and stationary plates.

Dimensional Analysis: Introduction, dimensions of physical quantities, dimensional homogeneity, Buckingham Pi-theorem, dimensionless numbers, similitudes, Reynolds model law, Mach model law.

**Text books:**

1. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala, 2nd Ed., Tata McGraw Hill.
2. Fluid Mechanics, Dr.Bansal, R.K.Lakshmi Publications, 2004.
***3. Streeter V L, Benjamin Wylie E, Bedford K W Fluid Mechanics, WCB/Mcgraw Hill 1998.***

**Reference Books:**

1. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and hydraulics, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
3. Fluid Mechanics, John F. Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006.
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons, 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning.

**Scheme of Examination:**

Two questions to be set from each module. Students have to answer five full questions choosing at least one full question from each module.

## APPLIED THERMODYNAMICS

**Semester: IV**

| Course | Code | Credits | Total Hours - 50 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Applied Thermodynamic | 21ME43 | 04 | 03 | 02 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1) To introduce student about basic physics, chemistry behind thermodynamics and gas power cycle
2) To study basic concepts of SI and CI engine .
3) To study the different types of cycle used in industrial application and also the concept of rocket and jet propulsion
4) To study application of gas and steam turbine used in various thermodynamic application
5) To study different types of turbines and corresponding velocity diagrams.
6) To study different types of compressor and their related efficiency.
7) (Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

**Module-1**(10 hours)

**Gas power cycle:** Air Standard cycles: Carnot, Otto, Diesel, Dual and Stirling cycles, P-V and T-S diagrams, description, efficiencies and mean effective pressures, Comparison of Otto,
Diesel and dual cycles, numerical problems

**Module-2** (10 hours)

**I.C. Engine**: Testing of two stroke and four stroke SI and CI engines for performance Related
numerical problems, heat balance, Motoring Method, Willian's line method, swinging field dynamometer, Morse test, related numerical problems.

**Module-3** (10 hours)

**Vapour Power cycles:** Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration, numerical problems.

**Jet Propulsion:** Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine

**Module-4** (10 hours)

**Gas Turbine:** Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles, numerical problems.

**Impulse Turbines:** Principles of operation, Classification, Impulse and reaction steam turbine, compounding of steam turbines, Velocity diagrams, Work done, Efficiencies, End

thrust, Blade friction, Influence of ratio of blade speed to steam speed on efficiency of single turbines and its condition curve and reheat factors. related numerical problems.

**Reaction Turbines** Flow through impulse reaction blades, Velocity diagram, and degree of reaction, Parson's reaction turbine, Performance of steam turbines, related numerical problems.

**Module-5** (10 hours)

**Compressors:** Reciprocating Air Compressor, Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistage compressors – Constructional details of multistage compressors, Need of multistage, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors, numerical problems.

Rotary Air Compressors- Classification, Difference between compressors and blowers, Working and constructional details of roots blower, Screw type and vane type compressors, numerical problems**.**

**COURSE OUTCOMES:**

The student will be able to

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Understand basic concepts of physics and chemistry behind thermodynamics. Solve introductory problems on gas cycle | U & AP |
| CO2 | Understand basic concepts of SI and CI engines, related problem's on different methods of engine. Explain the functioning and features of IC engines, components and auxiliaries. | U & Ap |
| CO3 | Understand concept of Vapour power cycle and solve introductory problems on various cycle. | U & AP |
| CO4 | Understand basic concepts of Impulse turbine, Reaction turbine and Gas turbine. Explain the flow in steam turbines, draw velocity diagrams for steam turbines and solve problems. | U & AP |
| CO5 | Understand basic concepts, reciprocating and rotary compressor. | U & AP |
| | **Total Number Lecture hours** | **50** |

**TEXT BOOKS:**


1) Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2000
2) .Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering",
   Fifth Edition, "Dhanpat Rai & sons , 2002


**REFERENCE BOOKS:**


1) Basic and Applied Thermodynamics by P.K. Nag, MCGRAW HILL INDIA
2) Applied thermodynamics by Onkar Singh, New Age International
3) Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education
4) Applied Thermodynamics by Venkanna And Swati, PHI
5) Theory of Stream Turbine by WJ Kearton

6) Gas turbine Theory & Practice, by Cohen & Rogers, Addison Weslay Long man
7) Gas Turbine, by V. Ganeshan, Tata McGraw Hill Publishers.
8) Steam & Gas Turbine by R. Yadav, CPH Allahabad
9) Thermodynamics and Energy Systems Analysis, Borel and Favrat, CRC Press
10) Thermodynamics by Prasanna Kumar, Pearson
11) Thermal Engineering by Kulshrestha, Vikas Publishing.
12) Thermal Engg. By PL Ballaney, Khanna Publisher
13) Thermal Engg. By RK Rajput, Laxmi Publication
14) Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
15) Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 1994
16) Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2007
17) Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003

**DATA HANDBOOKS:**

D1. Thermodynamic data hand book, B.T. Nijaguna.
D2. Thermodynamic data hand book, R K Hegde.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

## INSTRUMENTATION AND METROLOGY

**Semester: IV**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Mechanical Measurements And Metrology | 21ME44 | 03 | 03 | 00 | 50 | 50 | 03 |

### COURSE OBJECTIVES

1. To provide knowledge on various Metrological equipments available to measure the dimension of the components.
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

**Module -1** Basics Of Metrology(6 Hours)

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

**Module -2** Linear And Angular Measurements (10 Hours)

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

**Module -3** Advances In Metrology(12 Hours)

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

**Module -4** Form Measurement(12 Hours)

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

**Module -5** Measurement Of Power, Flow And Temperature(10 Hours)

Force, torque, power – mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Describe the concepts of measurements to apply in various metrological instruments. | U |
| CO2 | Outline the principles of linear and angular measurement tools used for industrial applications. | Ap |
| CO3 | Explain the procedure for conducting computer aided inspection. | U |
| CO4 | Demonstrate the techniques of form measurement used for industrial components. | Ap |
| CO5 | Discuss various measuring techniques of mechanical properties industrial applications. | Ap |
| | **Total Number Lecture hours** | **50** |

**Text Books:**


1. Jain R.K. “Engineering Metrology”, Khanna Publishers.
2. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.


**Reference Books:**


1. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.
2. Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2006.


**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# FLUID MECHANICS LAB

**Semester: IV**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| fluid mechanics lab | 21MEL45 | 01 | 00 | 02 | 50 | 50 | 03 |

**OBJECTIVES:**

Upon Completion of this subject, the students can able to have hands on experience in flowmeasurements using different devices and also perform calculation related to losses in pipesand also perform characteristic study of pumps, turbines etc.

**LIST OF EXPERIMENTS:**

**PART-A**

1) Study of taps, valves, pipe fittings, gauges, pitot tubes, water meters and current meters.
2) Calibration of Pressure gauges
3) Determination of metacentric height and radius of gyration of floating bodies.
4) Verification of Bernoulli's theorem
5) Reynolds experiment

**PART-B**

6) Hydraulic coefficients of orifices and mouth pieces under constant head method and time of emptying method.
7) Determination of the Coefficient of discharge of given Orifice meter.
8) Determination of the Coefficient of discharge of given Venturi meter.
9) Determination of the Coefficient of discharge of given V-Notch $60^0$, $90^0$ and Rectangular notch
10) Determination of force due to impact of jets.
11) Determination of friction factor for a given set of pipes.
    a) Major loss.
    b) Minor loss.

**OUTCOMES:**

1) Ability to use the measurement equipments for flow measurement.
2) The students will be able to understand the different flow measurement equipment's and their procedures.
3) Able to develop the skill of experimentation techniques for the study of flow phenomena in channels/pipes.

**Scheme of Examination:**

ONE question from part -A: 30 Marks
ONE question from part -B: 50 Marks
Viva -Voice: 20 Marks
Total : 100 Marks

## INSTRUMENTATION AND MEASUREMENT LAB

**Semester: IV**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Tutorial | Practical | SEE | CIE | |
| Instrumentation and Measurement Lab | 21MEL46 | 01 | 00 | 02 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
2. To illustrate the use of various measuring tools measuring techniques.
3. To understand calibration techniques of various measuring devices.

**PART-A:**

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.

**PART-B:**

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using a) Lathe tool Dynamometer OR b) Drill tool Dynamometer.
5. Measurements of Screw thread Parameters using two wire or Three-wire methods.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges
9. Measurement using Optical Flats

**COURSE OUTCOME**

1. To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer
2. To measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
3. To demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
4. To measure cutting tool forces using Lathe/Drill tool dynamometer.
5. To measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.
6. To measure surface roughness using Tally Surf/ Mechanical Comparator.

Scheme of Examination:

| | |
|---|---|
| ONE question from part -A: | 30 Marks |
| ONE question from part -B: | 50 Marks |
| Viva -Voice: | 20 Marks |
| Marks Total : | 100 Marks |

## FOUNDRY AND FORGING LAB

**Semester: IV**

| Course | Code | Credits | Total Hours - 50 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| Foundry and Forging lab | 21MEL47 | 02 | 01 | 02 | 50 | 50 | 03 |

**COURSE OBJECTIVES:**

1. To provide an insight into different sand preparation and foundry equipment's.
2. To provide an insight into different forging tools and equipment's.
3. To provide training to students to enhance their practical skills.
4. To practically demonstrate precautions to be taken during casting and hot working.
5. To develop team qualities and ethical principles.

### PART A

1. **Testing of Molding sand and Core sand**

Preparation of sand specimens and conduction of the following tests:

1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2. Permeability test
3. Sieve Analysis to find Grain Fineness Number(GFN) of Base Sand
4. Clay content determination in Base Sand.

### PART B

**2. Foundry Practice**

1. Use of foundry tools and other equipment's.
2. Preparation of molding sand mixture.
3. Preparation of green sand molds using two molding boxes kept ready for pouring.

• Using patterns (Single piece pattern and Split pattern)

• Without patterns.

• Preparation of one casting (Aluminum or cast iron-Demonstration only)

### PART C

**3. Forging Operations :**

Use of forging tools and other equipment's

• Calculation of length of the raw material required to prepare the model considering scale loss.

• Preparing minimum three forged models involving upsetting, drawing and bending operations.

• Demonstration of forging model using Power Hammer.

**COURSE OUTCOMES**

Students will be able to

1. Demonstrate various skills of sand preparation, molding.
2. Demonstrate various skills of forging operations.
3. Work as a team keeping up ethical principles.

| **Question paper pattern:** | |
|---|---|
| One question is tobe set from Part-A | 30 Marks |
| One question is tobe set from part-B or part-C model | 50 Marks |
| Viva – Voce | 20 Marks |

# MINI PROJECT-IV

**Semester: IV**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| Mini project-IV | 21MEMP48 | 01 | 00 | 02 | 50 | 50 | 02 |

**OBJECTIVES:**

To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

**Mini-project work:**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

| | | | |
|---|---|---|---|
| «µÀAiÀÄ ¸ÀAPÉÃvÀ Subject Code | 21KK46 | CIE Marks DAvÀjPÀ ¥ÀjÃPÁë CAUÀ¼ÀÄ | 50(50) |
| MlÄÖ G¥À£Áå¸À CªÀ¢ü UÀAmÉ/ªÁgÀ Number of Lecture Hours/Week | 03(03) | SEE Marks | 50(50) |
| MlÄÖ G¥À£Áå¸À CªÀ¢ü Total Number of Lecture Hours | 42(42) | Exam Hours ¥ÀjPÁë CªÀ¢ü | 03(03) |
| **Qærmï -01 CRIDETS – 01**<br>1) PÀ£ÀßqÀ ¨sÁµÁ eÁÕ£ÀzÀ CjªÀÅ ªÀÄÆr¸ÀÄªÀÅzÀÄ.<br>2) PÀ£ÀßqÀ §gÀªÀtÂUÉ PÀÄjvÀÄ w¼ÀÄªÀ½PÉ ªÀÄÆr¸ÀÄªÀÅzÀÄ.<br>3) PÀ£ÀßqÀ £ÁqÀÄ £ÀÄr, ¸ÀA¸ÀÌøwAiÀÄ §UÉÎ w½¸ÀÄªÀÅzÀÄ.<br>4) PÀ£ÀßqÀ ¨sÁµÁ ¥ÉæÃªÀÄªÀ£ÀÄß ¨É¼É¸ÀÄªÀÅªÀÅzÀÄ. | | | |
| **WÀlPÀ 1 (Module 1)** | | | **Teaching Hours G¥À£Áå¸À CªÀ¢ü** |
| 1) ±ÀgÀt§¸ÀªÉÃ±ÀéªÀgÀgÀ §zÀÄPÀÄ (CgÀ¼ÀUÀÄArUÉAiÀÄ°è)<br>2) ¸ÁzsÀ£ÁPÉëÃvÀæ (OgÁzÀ, ¥ÀvÁð¨Ázï ªÀÄvÀÄÛ PÀ®§ÄgÀVAiÀÄ°è) | | | **10(10)** |
| **WÀlPÀ 2 (Module 2)** | | | |

| | |
|---|---|
| 3) zÉÆqÀØ¥Àà C¥Àà ºÁUÀÆ ±ÀgÀt§¸ÀªÀ¥Àà CªÀgÀ ¸ÀA§AzsÀUÀ¼ÀÄ (1 jAzÀ 6£ÉÃ ¦ÃoÁ¢ü¥ÀwUÀ¼ÀÄ)<br>4)ªÀÄgÀÄ¼À ±ÀgÀt§¸À¥Àà (zÉÃªÁ®AiÀÄ ¤ªÀiÁðt, zÁ¸ÉÆÃºÀ ªÀÄºÁªÀÄ£ÉAiÀÄ ¨É¼ÀªÀtÂUÉ) | **8(8)** |
| **WÀlPÀ 3 (Module 3)** | |
| 5) ¥ÀÆdå zÉÆqÀØ¥Àà C¥Àà (zsÁ«ÄðPÀ ¸ÁzsÀ£É)<br>6) ±ÉÊPÀëtÂPÀ ¸ÁzsÀ£ÉUÀ¼ÀÄ | **8(8)** |
| **WÀlPÀ 4 (Module 4)** | |
| 7) ¥ÀÆdå qÁ. ±ÀgÀt§¸ÀªÀ¥ÀàC¥Àà (¸ÁªÀiÁfPÀ PÉÆqÀÄUÉUÀ¼ÀÄ)<br>8) ±ÉÊPÀëtÂPÀ PÉÆqÀÄUÉUÀ¼ÀÄ | **8(8)** |
| **WÀlPÀ 5 (Module 5)** | |
| 9) ªÀÄºÁªÀÄ£ÉAiÀÄ ªÀÄºÁ ªÀiÁvÉAiÀÄgÀÄ ªÉÆzÀ® £Á®ÄÌ ¥ÀÄtå¹ÛçÃAiÀÄgÀÄ<br>10) LzÀ£ÉAiÀÄ ¦ÃoÁ¢ü¥ÀwUÀ½AzÀ 8£ÉÃ ¦ÃoÁ¢ü¥ÀwUÀ¼À ¥ÀÄtå¹ÛçÃAiÀÄgÀÄ | **8(8)** |
| 1) ¸ÀgÀPÁj DqÀ½vÀ PÀZÉÃj PÀqÀvÀUÀ¼À §UÉÎ CjvÀÄPÉÆ¼ÀÄîvÁÛgÉ.<br>2)ªÀåªÀºÁgÀzÀ°è PÀ£ÀßqÀ §¼ÀPÉAiÀÄ ªÀÄºÀvÀéªÀ£ÀÄß w½zÀÄPÉÆ¼ÀÄîvÁÛgÉ.<br>3)¨sÁµÁ©üªÀiÁ£ÀªÀ£ÀÄß ¥ÀqÉzÀÄPÉÆ¼ÀÄîvÁÛgÉ.<br>4)PÀ£ÀßqÀ ¸Á»vÀå PÀÈwUÀ¼À §UÉÎ D¸QÛ ªÀÄÆqÀÄvÀÛzÉ.<br><br>¥ÀgÀªÀÄ±Àð£À UÀæAxÀUÀ¼ÀÄ:<br>1) ªÀÄºÁzÁ¸ÉÆÃ»UÀ¼ÀÄ : ¥Àæ¸ÁgÁAUÀ ±ÀgÀt§¸ÀªÀ «±Àé«zÁå®AiÀÄ PÀ®§ÄgÀV | |

# SHARNBASVA UNIVERSITY, KALABURAGI

**Scheme of Teaching and Examination 2021-22**

**Outcome Based Education(OBE) and Choice Based Credit System (CBCS)**

**(Effective from the academic year 2021-22)**

**V SEMESTER B.Tech. (MECHANICAL ENGINEERING)**

| Sl.No | Category | Course Code | Course Title | Teaching Dept. & Paper Setting Board | Teaching Hours/week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total Contact Hours | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| 1 | HSMC | 21HSMC51 | Management and Entrepreneurship Development | Humanities | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 2 | PCC | 21ME52 | Mechanics of Materials | ME | 3 | 1 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 3 | PEC | 21ME53X | Professional Elective -1 | ME | 3 | 1 | | 04 | 3 | 50 | 50 | 100 | 04 |
| 4 | OEC | 21XX54X | Open Elective -1 | ME | 3 | | | 03 | 3 | 50 | 50 | 100 | 03 |
| 5 | PCC | 21MEL55 | Fluid machines Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 6 | PCC | 21MEL56 | Machine shop Lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 7 | PCC | 21MEL57 | Design /Machine dynamics lab | ME | | | 2 | 02 | 3 | 50 | 50 | 100 | 01 |
| 8 | MP | 21MEMP58 | Project-V | ME | | | 2 | 02 | 2 | 50 | 50 | 100 | 01 |
| 9 | HSMC | 21HSM59 | Professional Ethics | Humanities | | | 2 | 02 | 2 | 50 | 50 | 100 | 01 |
| **Total** | | | | | **13** | **02** | **10** | **25** | **25** | **450** | **450** | **900** | **19** |

Category: PCC-Professional Core Course , PEC- Professional Elective Course, OEC- Open Elective Course, HSMC-Humanity and Social Science Course, MP-Mini Project

| **rofessional Elective-1** | | **Open Elective-1** | |
|---|---|---|---|
| 18ME531 | Machine Tools Operations | 18ME541 | Refrigeration and air conditioning |
| 18ME532 | Computational Fluid dynamics | 18ME542 | Supply chain Management |
| 18ME533 | Turbo machines | 18ME543 | Alternative fuels for transportation |

| | | | |
|---|---|---|---|
| 18ME534 | Composite material technology | 18ME544 | Micro-electromechanical system |

# MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

**Semester: V**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Management and Entrepreneurship Development | 21HSM51 | 03 | 03 | 00 | 50 | 50 | 03 |

**Course Objectives: The course aims**:

1. Explain fundamentals management functions of a manager. Also explain planning and decision making processes.
2. Explain the organizational structure, staffing and leadership process.
3. Describe the understanding of motivation and different control systems in management.
4. Explain understanding of Entrepreneurships and Entrepreneurship development process.
5. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
6. Summarize the preparation of project report, need significance of report.

**MODULE 1** **08 Hours**

**INTRODUCTION**

Introduction - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, brief overview of evolution of management theories,. Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection

**MODULE 2** **08 Hours**

**ENTREPRENEUR**

Meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study.

**MODULE 3** **08 Hours**

**PROJECT AND ERP**

Meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation

**MODULE 4** **08 Hours**

**SMALL AND MEDIUM ENTERPRISES**

Meaning and definition (evolution) Role and importance, Policies governing SMEs Organizational structure Steps in setting up a small unit ,SME funding. Requirements of capital (fixed and working), Factors determining capital requirements, Importance of fixed and working capital, Working capital management, Sources of finance for SME'S. Taxation benefits. SIDBI and SISI – Their role in the development of SMEs. Taxation benefits SIDBI and SISI – Their role in the development of SMEs. Marketing mechanism in SMEs Problems of SMEs and prospects Turnaround strategies for SMEs

**MODULE 5** **08 Hours**

**SOCIAL RESPONSIBILITY AND MANAGERIAL ETHICS**

Social Responsibility, Social Responsibility and Economic Performance, The Greening of Management – Social Obligation, Social Responsiveness and Social Responsibility, Value Based Management, Managerial Ethics, Different NGOs, Social Responsibility and Ethics Issues in Today's World

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship | U |
| CO2 | Utilize the resources available effectively through ERP | Ap |
| CO3 | Explain the organizational structure, staffing and leadership processes | Ap |
| CO4 | Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur | Ap |
| CO5 | Understands the Social Responsibility and Economic Performance | U |

**TEXT BOOKS:**

1. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House
2. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill.
3. Dynamics of Entrepreneurial Development & Management-Vasant Desai,Himalaya PublishingHouse.
4. Entrepreneurship Development – Poornima. M. Charantimath, Small Business Enterprises – PearsonEducation - 2006 (2 & 4).

**REFERENCE BOOKS:**

1. Management Fundamentals - Concepts, Application, Skill Development – RobersLusier, Thomson.
2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi.
3. Management - Stephen Robbins, Pearson

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

## MECHANICS OF MATERIALS

**SEMESTER: V**

| Course | Code | Credits | Total Hours-50 | | Assessment | | Exam Duration in Hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours/Week | | | | |
| Mechanics of Materials | 21ME52 | 04 | Lecture | Tutorial | SEE | CIE | |
| | | | 03 | 01 | 50 | 50 | 03 |

**COURSE OBJECTIVES:**

1. To study different types of stresses, strain and deformation induced in the mechanical components due to external loads.
2. To study the behaviour of beams under transverse loading.
3. To study behaviour of structural members in Torsion.
4. To understand stability of columns.
5. To predict the stress distribution in pressure vessels.

**MODULE: I** **12 Hours**

Simple Stress and Strain: Introduction, Properties of Materials, stress, strain, Hook's law, Poisson's Ratio, Stress-Strain diagrams, Principles of super position, total elongation of tapering bars of circular and rectangular cross sections. Stresses due to temperature change.

Volumetric strain: Expression for volumetric strain, elastic constants relationship among Elastic constants, thermal stresses including compound bars.

**MODULE: II** **10 Hours**

Principal stresses and strains: Principal planes, principal stresses and strains, biaxial state of stress combined with shear, concept of Mohr's circle diagram.

Theories of Failures: Maximum Principal stress theory, Maximum shear stress theory, Maximum strain theory, Maximum strain energy theory and Maximum Distortion energy theory.

**MODULE: III** **08 Hours**

Shear Forces and Bending Moments: Type of beams, Loads and reactions, Relationship between loads, shear force and bending moments. Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads and uniformly distributed constant / varying loads.

**MODULE: IV** **10 Hours**

Stress in Beams: Pure bending, curvature of beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses.

Elastic stability of columns: Euler's theory for axially loaded elastic long columns. Rankine's formula. Derivation of Euler's load for various end conditions.

**MODULE: V** **10 Hours**

Torsion of shafts: Assumptions in theory of pure torsion, Torsion equations, Torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Numerical problems.

Thick and Thin cylinders: Stresses in thin cylinders, Changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation).

**COURSE OUTCOMES:**

| | Course Outcomes | Course Level |
|---|---|---|
| **C01** | To demonstrate fundamental knowledge about various types of loading and stresses induced in elastic bodies. | U |
| **C02** | To determine plane stress, principal stress and maximum shear stress using Mohr's circle. | Ap |
| **C03** | To Draw the SFD and BMD for different types of loads and support conditions. | U |
| **C04** | To Analyse buckling and bending phenomenon in columns and beams. | Ap |
| **C05** | To give an ability to apply the knowledge of mechanics of materials on engineering applications and design problems. | Ap |
| | **Total Number of Lecture hours** | **50** |

**TEXT BOOKS:**

1.Strength of Materials by S.S. Bhavikatti ,Vikas Publications House Pvt. Ltd. New Delhi,2012
2.Strength of Materials by R K Bansal, Laxmi Publication Pvt Ltd.,2016
3.Strength of Materials by R Subramanian, Oxford university press, 2010.
4.Strength of Materials by S.Ramamrutham, Dhanapath Rai Publishing Company, New Delhi,2012

**REFERENCE BOOKS:**

1.Mechanics of Materials by James Gere, Thomson Publication, 2010.
2.Strength of Materials by S S Rattan, McGraw Hill, 2011.
3.Mechanics of materials by Ferdinand Beer and Russell Johston , Tata McGraw Hill, 2003.

**SCHEME OF EXAMINATION:**

- Two questions to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# MACHINE TOOL OPERATION

**Semester: V**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Machine Tool Operation | 21ME531 | 03 | 03 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To introduce students to different machine tools in order to produce components having different shapes and sizes.
2. To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
3. To develop the knowledge on mechanics of machining process and effect of various parameters on economics of machining.

**MODULE-1(08 HOURS)**

**INTRODUCTION TO MACHINE TOOLS**

Introduction, Classification, construction and specifications of lathe, drilling machine, milling machine, boring machine, broaching machine, shaping machine, planing machine, grinding machine [Simple sketches showing major parts of the machines

**MODULE-2 (08 HOURS)**

**MACHINING OPERATIONS**

Introduction, Types of motions in machining, turning and Boring, Shaping, Planing and Slotting, Thread cutting, Drilling and reaming, Milling, Broaching, Gear cutting and Grinding, Machining parameters and related quantities.[Sketches pertaining to relative motions between tool and work piece only]

**MODULE – 3(08 HOURS)**

**CUTTING TOOL MATERIALS, FLUIDS &GEOMETRY**

Introduction, desirable Properties and Characteristics of cutting tool materials, cutting toolgeometry(Single point cutting tool, Twist drill bit & milling cutter), cutting fluids and its applications. Machining equations for cutting operations: Turning, Shaping, Planing, slab milling, cylindrical grinding and internal grinding, simple numerical.

**MODULE – 4 (08 HOURS)**

## MECHANICS OF MACHINING PROCESSES

Introduction, Chip formation, Orthogonal cutting, Merchants model for orthogonal cutting, Oblique cutting, Mechanics of turning process, Mechanics of drilling process, Mechanics of milling process, Numerical problems

## MODULE – 5(08 HOURS)

## TOOL WEAR, TOOL LIFE& FINISHING

Introduction, tool wear mechanism, tool wear equations, tool life equations, effect of process parameters on tool life, machinability, Numerical problems. Surface finishing, Super finishing process, effect of machining parameters on surface finish, polishing, buffing operation and application.

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Identify and explain the construction and specifications of different types of machine and tools used for various machining operations. | U |
| CO2 | **Describe various machining processes pertaining to relative motions between tool & work piece.** | Ap |
| CO3 | Discuss different cutting tool materials, tool nomenclature & surface finish. | Ap |
| CO4 | Apply mechanics of machining process to evaluate machining time. | Ap |
| CO5 | Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost | Ap |
| | **Total Number Lecture hours** | **50** |

U*=Understanding Ap*=Application

**TEXT BOOKS:**


7. "Manufacturing Process-II", Dr.K.Radhakrishna, Sapna Book House,5th Revised Edition 2009.
8. "Manufacturing & Technology:",P.N.Rao, 3rd Ed., Tata McGraw
9. "Machine tools & operations", AnupGoel, Technical publications,2nd edition 2018.
10. "Machine tools and operations", Sagar M. Baligidad, Sunsatar publishers,1st edition 2017.
11. "Metal cutting and machine tool engineering", Pakirappa, Durga publishing house, 3rd edition 2015-16.
12. "Manufacturing process-2", Kestoor Praveen, Suggi publishing,5th edition 2013.


**REFERENCE BOOKS:**


7. "Process and Materials of Manufacturing", Roy A Lindberg, 4th Ed.PearsonEdu. 2006.

8. “Manufacturing Technology”, SeropeKalpakjian, Steuen. R. Sechmid,Pearson Education Asia, 5th Ed. 2006.
9. “Principles of metal casting”, Rechard W. Heine, Carl R. LoperJr.,Philip C. Rosenthal, Tata McGraw Hill Education Private Limited Ed.1976
10. “Fundamental of Machining and Machine Tools”, Geoffrey Boothroyd and Winston A. Knight, CRC Taylor& Francis, Third Edition.
11. “All about Machine Tools”, Heinrich Gerling, New Age International Publishers revised 2nd Edition, 2006
12. “Metal cutting principles”, Milton C. Shaw, Oxford University Press, Second Edition,2005.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# COMPUTATIONAL FLUID DYNAMICS

**Semester: V** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| **Computational Fluid Dynamics** | 21ME532 | 04 | 03 | 0 | 50 | 50 | 03 |

**Course Objectives:**

1. To study the CFD applications,
2. To describe grid generation and Body-fitted coordinate system
3. To describe Differentiate the FDM, FVM and FEM

## MODULE-1

### INTRODUCTION:

CFD Applications. Need for Parallel Computers in CFD algorithms. Models of flows. Substantial derivative, Divergence of velocity. Continuity, Momentum, and Energy Equations-Derivation in various forms. Integral versus Differential form of equations. Comments on governing equations. Physical boundary conditions. Forms of equations especially suitable for CFD work. Shock capturing, and shock fitting. 08 Hours

## MODULE-2

### MATHEMATICAL BEHAVIOUR OF PARTIAL DIFFERENTIAL EQUATIONS:

Classification of partial differential equations. Cramer Rule and Eigen value methods for classification. Hyperbolic, parabolic, and elliptic forms of equations. Impact of classification on physical and computational fluid dynamics. Case studies: steady inviscid supersonic flow, unsteady inviscid flow, steady boundary layer flow, and unsteady thermal conduction, steady subsonic inviscid flow. 08 Hours

## MODULE-3

### GRID GENERATION AND ADAPTIVE GRIDS:

Need for grid generation and Body-fitted coordinate system. Structured Grids-essential features. Structured Grid generation techniques- algebraic and numerical methods. Unstructured Grids-essential features. Unstructured Grid generation techniques- Delaunay-Voronoi diagram, advancing front method. Surface grid generation, multi-block grid generation, and meshless methods. Grid quality and adaptive grids. Structured grids adaptive methods and unstructured grids adaptive methods. 08 Hours

## MODULE-4

### DISCRETISATION & TRANSFORMATION:

Discretisation: Finite differences methods, and difference equations. Explicit and Implicit approaches. Unsteady Problem -Explicit versus Implicit Scheme. Errors and stability analysis. Time marching and space marching. Reflection boundary condition. Relaxation techniques. Alternating direction implicit method. Successive over relaxation/under relaxation. Second order Lax-Wendroff method, mid-point Leap frog method, upwind scheme, numerical viscosity, and artificial viscosity. 08 Hours

## MODULE-5

### FINITE VOLUME TECHNIQUE AND SOME APPLICATIONS:

Spatial discretisation- cell centered and cell vertex techniques (overlapping control volume, duel control volume). Temporal discretisation- Explicit time stepping, and implicit time stepping. Time step calculation. Upwind scheme and high resolution scheme. Flux vector splitting, approximate factorisation. Artificial dissipation and flux limiters. Unsteady flows and heat conduction problems. Upwind biasing. 08 Hours

### COURSE OUTCOMES:

The student will be able to

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Differentiate the FDM, FVM and FEM | U |
| CO2 | Perform the flow, structural and thermal analysis. | Ap |
| CO3 | Utilize the discretization methods according to the application. | Ap |
| CO4 | Need for grid generation and Body-fitted coordinate system | Ap |
| CO5 | CFD Applications. Need for Parallel Computers in CFD algorithms | Ap |

### TEXT BOOKS:

1. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Springer, Berlin,2nd edition, 2002,ISBN-13: 978-3540543046

2. John D. Anderson, "Computational Fluid Dynamics", McGraw Hill, 2013, ISBN-13: 978-0070016859

**REFERENCE BOOKS:**

1. John F. Wendt, "Computational Fluid Dynamics - An Introduction", Springer, 3rd edition,2013

2. Charles Hirsch, "Numerical Computation of Internal and External Flows", Elsevier,1st edition, 2007, ISBN-13: 978-9381269428.

3. Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 - 1078 USA, 1993.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# TURBOMACHINES

**Semester: V**

| Course | Code | Credits | Total Hours-50 | | Assessment | | Exam Duration Hours |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Turbomachines | 21ME533 | 04 | 03 | 01 | 50 | 50 | 03 |

**COURSE OBJECTIVES:**

1. The main objective of these specialized courses is to familiarize the students with the main theories and tools for the interpretation of numerical and experimental results and the design techniques for advanced turbomachinery components.
2. The first part provides the basis for the more specialized studies in turbines or compressors in the second part of this course program. The formal lectures are completed with the aero design of advanced turbomachinery components to put the learned lessons into practice.
3. The targeted courses prepare the student for a position in a turbomachinery research center or the R&D department of a turbomachinery manufacturer.
4. To learn the working principles of Impulse and Reaction water turbines and also to study its velocity triangles. To study design parameters related to Turbines
5. To understand the concept of Centrifugal pumps and its construction. To understand MPSH and NPSH terms related to centrifugal pumps.
6. To study equations for specific speed of various turbines and pumps. To understand performance characteristics of various turbines and pumps.
7. To illustrate the concept of centrifugal compressor, Axial compressors. To understand various parameters related to rotodynamic air compressors.

**MODULE: 1**

**Introduction**: Fluid machines, classification of fluid machines, Definition of turbomachine, parts of turbomachines, Classification of turbomachine, Comparison with positive displacement machines, Dimensional analysis, Application of dimensional analysis to a general fluid flow, significance of Pie terms, Effect of Reynold's number, Unit quantities, Hydraulic model analysis, Application of first and second laws of thermodynamics to turbomachines, Efficiencies of turbomachines. Problems.

**MODULE: 2**

**Energy exchange in Turbomachines:** Euler's turbine equation, Alternate form of Euler's turbine equation, components of energy transfer, General Analysis of turbines (PGT): impulse, and reaction turbine, degree of reaction(R), efficiency and utilization factor, relation between degree of reaction and utilization factor.

Power absorbing turbomachine (PAT): Axial flow machine (axial flow compressor, blower, pumps) energy transfer, Degree of reaction (R), Radial Flow Machine (Centrifugal pumps, compressor, blowers) energy transfer, Degree of reaction (R), H-Q curve, types of centrifugal pump impeller, numerical.

**MODULE: 3**

**Steam Turbines:** Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor for two stage, numerical problems.

Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging, problems.

**MODULE: 4**

**Hydraulic Turbines: Introduction, classification of hydraulic turbine,** heads and efficiencies of hydraulic turbines, Pelton wheel: its velocity triangles, construction, working, work done and proportions of Pelton wheel, numerical problems (Calculation of bucket dimensions, Number of buckets, Jet diameter, Wheel diameter, Jet ratio, Speed ratio, Number of jets, efficiency, Power, Discharge etc.), performance characteristics of turbine

**Reaction Turbine**: (Francis and Kaplan turbine): its velocity triangles, construction, working, work done and proportions of reaction turbine, Draft tube, types of draft tube, numerical problem (calculation of various efficiencies, Power, Discharge, Blade angles, Runner dimensions etc.).

**MODULE: 5**

**Centrifugal Pumps:** Introduction, types, construction and working of pump, velocity triangle, terminology of centrifugal pump, pump losses and efficiencies, work done by centrifugal pump, pre-rotation, slip and slip coefficient, minimum starting speed, Multistage pumps, casing of centrifugal pump, Cavitation, Maximum permissible suction head (MPSH) and Net positive suction head (NPSH). Priming. Methods of priming, performance characteristics of pumps.

**Centrifugal Compressors**: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency, Chocking, Stalling, surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and Problems.

## Course Outcomes:

At the end of this course, student will be able to

| | COURSE OUTCOMES | COURSE LEVEL |
|---|---|---|
| **CO1** | **Understand the working concept of turbomachine and model studies.** | (L-1, L-2, L3) |
| **CO2** | **Understand the application and analysis of turbine.** | (L-1, L-2, L3, L-4) |
| **CO3** | Understand working principle of Impulse and Reaction turbine. | (L-1, L-2, L3, L-4) |
| **CO4** | Understand the concept of Centrifugal pumps and various efficiencies related to it. | (L-1, L-2, L3, L-4) |
| **CO5** | Understand the concept of centrifugal and Axial compressors. | (L-1, L-2, L3, L-4) |
| | **Total Number Lecture Hours** | **50** |
| | **NOTE: All levels mentioned are as per Bloom's Taxonomy** | |

**TEXT BOOKS:**


1. **"**Turbo machines", S.M. Yahya, Tata Mc Graw Hill, 2005
2. "Fans, compressor and turbine", S. M. Yahya, Tata Mc Graw Hill, 2005


**REFERENCES:**


18) Hydraulic Machines", V.P. Vasantdani, Khanna Publishers, 1996.2. "Fluid flow machines", N.S. Govind Rao, Tata McGraw-Hill,1983.

19) "Steam and gas Turbines", R. Yadav, Central Publishing House, Allahabad, 6th Edition, 1997.

20) "Gas Turbines", V. Ganeshan, Published by TMH Education Pvt. Ltd. , 3rd Edition.

21) "Thermal Engg.", Kumar vasantdani, Khanna publisher

22) "Thermal Engg.", P.L. Balleny, Khanna publisher. , 20th Edition

23) "Gas turbines and Compressor", Cohen and Rogers, Saravanamutto Publisher
24) "Thermodynamics and Heat Engines", R. Yadav, Vol-II, Central Publishing House.
25) "Fluid mechanics and hydraulic machines", Modi and Seth, Standard Book House, 2004
26) "Thermal Engineering", R K Rajput, Laxmi Publication.
27) "Fluid Mechanics and Hydraulic Machines", S.C. Gupta , Pearson Education, 1st Edition
28) "Fluid Mechanics and hydraulic machines",R. K. Rajput , S. Chand Publication.
29) "Fluid Mechanics and hydraulic machines",R. K. Bansal, L.P. Pub. House.

# COMPOSITE MATERIAL TECHNOLOGY

**SEMESTER:-V**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs. |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Composite material technology | 21ME534 | 03 | 03 | 00 | 50 | 50 | 03 |

**Course objectives:** The objectives of this course is to

1. Composite materials technology provides fundamental knowledge to composite material, classifications of composite materials based on matrix and reinforcements.
2. It gives basic information of manufacturing methods and also gives information of mechanical properties, geometrical aspects of composite materials.

## MODULE-1

## INTRODUCTION TO COMPOSITES

Definition, Composite Types of matrices and reinforcements, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

**08 Hours**

## MODULE-2

## FIBER REINFORCED PLASTIC PROCESSING

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, blow molding, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical.**08 Hours**

## MODULE-3

## METAL MATRIX COMPOSITES

Reinforcement materials, types, Characteristics and selection and base metals – Need for production and MMC's. Fabrication process for MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.**08 Hours**

**MODULE-4**

**STUDY OF PROPERTIES FOR MMC'S**

physical mechanical, wear, machinability and other properties. Effect of size, shape, and distribution of particulate on properties.**08 Hours**

**MODULE-5**

**APPLICATIONS OF COMPOSITES**

Automobile, Aircraft's, missiles, space hardware, electrical and electronics, marine, recreational and sports equipment, future potential of composites. **08 Hours**

**COURSE OUTCOMES:** The student will be able to

1. Develop basic fundamental understanding of the composite materials and structures and selection of materials in aerospace, mechanical engineering structures.
2. Learn about the different types of manufacturing methods of composite materials
3. Learn about the joining methods and failures.

**TEXT BOOKS:**

1. Composite Materials handbook, Mein Schwartz Mc Graw Hill Book Company, 1984.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.

**REFERENCE BOOKS:**

1. Mechanics of Composite Materials, Rober M. Joness Mc-Graw Hill Kogakusha Ltd.
2. Stress analysis of fiber Reinforced Composite Materials, Michael W, Hyer Mc-Graw Hill International.
3. Composite Material Science and Engineering, Krishan K. Chawla Springer.
4. Fibre Reinforced Composites, P.C. Mallik Marcel Decker.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# REFRIGERATION AND AIR-CONDITIONING

**Semester: V**

| Course | Code | Credits | Total Hours-50 Hours /Week | | Assessment | | Exam Duration Hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Refrigeration and Air -Conditioning | 21ME541 | 04 | 03 | 01 | 50 | 50 | 03 |

**COURSE OBJECTIVES:**

1. Study the basic definition, ASHRAE nomenclature for refrigerating systems
2. Understand the working principles and application of different types of refrigeration system
3. Study the working of air conditioning system and their applications
4. Identify the performance parameters and their relations of an air conditioning system.

## MODULE: 1

**Introduction to Refrigeration –Basic Definitions, ASHRAE Nomenclature, Air Refrigeration, Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and, demerits and applications: Aircraft refrigeration cycles, Joule Thompson coefficient and Inversion Temperature, Linde, Claude and Stirling cycles for liquefaction of air.**

**Industrial Refrigeration- Chemical and process industries, Dairy plants, Petroleum refineries, Food processing and food chain, Miscellaneous**

**10Hours**

## MODULE: 2

Vapour Compression Refrigeration System(VCRS): Comparison of Vapour Compression Cycle and Gas cycle, Vapour Compression Refrigeration system Working and analysis, Limitations, Superheat horn and throttling loss for various refrigerants, efficiency, Modifications to standard cycle – liquid-suction heat exchangers, Grindlay cycle and Lorenz cycle, Optimum suction condition for optimum COP – Ewing's construction and Gosney's method.

Actual cycles with pressure drop, Complete Vapour Compression Refrigeration System, Multi-Pressure, Multi-evaporator systems or Compound Vapour Compression Refrigeration Systems – Methods like Flash Gas removal, Flash inter cooling and water Inter cooling

**10Hours**

## MODULE: 3

Vapour Absorption Refrigeration Systems: Absorbent – Refrigerant combinations, WaterAmmonia Systems, Practical problems, Lithium- Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia System with Rectifier and Analyzer Assembly.

Practical problems – crystallization and air leakage, Commercial systems Other types of Refrigeration systems: Brief Discussion on (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration, pulse tube refrigeration, thermo acoustic refrigeration systems.

**10Hours**

**MODULE: 4**

Refrigerants: Primary and secondary refrigerants, Designation of Refrigerants, Desirable properties of refrigerants including solubility in water and lubricating oil, material compatibility, toxicity, flammability, leak detection, cost, environment and performance issues Thermodynamic properties of refrigerants, Synthetic and natural refrigerants, Comparison between different refrigerants vis a vis applications, Special issues and practical implications Refrigerant mixtures – zeotropic and a zeotropic mixtures Refrigeration systems Equipment: Compressors, Condensers, Expansion Devices and Evaporators.

**10Hours**

**MODULE: 5**

**Air-Conditioning: Introduction to Air-Conditioning, Basic Definition, Classification, power rating, ASHRAE Nomenclature pertaining to Air-Conditioning, Applications of Air-Conditioning, Mathematical Analysis of Air-Conditioning Loads, Related Aspects, Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air Conditioner and Packaged Air Conditioner, Components related to Air-Conditioning Systems. Transport air conditioning Systems: Air conditioning systems for automobiles (cars, buses etc.), Air conditioning systems for trains, Air conditioning systems for ships.**

**10Hours**

## COURSE OUTCOMES

At the end of this course, student will be able to

| | COURSE OUTCOMES | COURSE LEVEL |
|---|---|---|
| **CO1** | Illustrate the principles, nomenclature and application of refrigeration system | **(L-1, L-2, L3)** |
| **CO2** | Explain vapour compression refrigeration system and identify methods for performance | **(L-1, L-2, L3, L-4)** |
| **CO3** | Study the working principle of air, vapour absorption, thermoelectric and steam – jet and thermo-acoustic refrigeration system | **(L-1, L-2, L3, L-4)** |
| **CO4** | Estimate the performance of air -conditioning system using the principles of psychometry. | **(L-1, L-2, L3, L-4)** |
| **CO5** | **Compute and interpret cooling and heating loads in an air conditioning system and identify suitable refringent for various refrigerating system.** | **(L-1, L-2, L3, L-4)** |
| | **Total Number Lecture Hours** | **50** |
| | **NOTE: All levels mentioned are as per Bloom's Taxonomy** | |

**TEXT BOOKS:**


30) Roy J. Dossat, Principles of Refrigeration, Wiley Limited

31) Arora C.P., Refrigeration and Air-conditioning, Tata Mc Graw –Hill, New Delhi, 2nd Edition,2001.

32) Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, Mc Graw - Hill, New Delhi 2nd edition, 1982.


**REFERENCES:**


1. Dossat, Principles of Refrigeration Pearson-2006.
2. McQuistion, Heating, Ventilation and Air Conditioning, Wiley Students edition, 5th edition 2000.
3. PITA, Air conditioning 4rth edition, pearson-2005

4. Refrigeration and Air-Conditioning' by Manohar prasad
5. S C Arora& S Domkundwar, Refrigeration and Air-Conditioning Dhanpat Rai Publication

**DATA BOOK:**

1. Shan K. Wang, Handbook of Air Conditioning and Refrigeration, 2/e, 2001 McGraw-Hill, Education
2. Mathur M.L. & Mehta, Refrigerant and Psychrometric Properties (Tables & Charts) SI Units, F.S., Jain Brothers,2008

# SUPPLY CHAIN MANAGEMENT

**Semester: V**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| SCM | 21ME542 | 04 | 04 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

3. Demonstrate operational purchasing methods and techniques on supplier management and supply in specific business contexts.
4. 2. To provide an insight into the role of internet technologies and electronic commerce in supply chain operations and to discuss technical aspects of key ITEC components in supply chain management.

**Module 1 Introduction to SCM:**

Basic concepts & philosophy of SCM, essential features, decision phases – process view, supply chain framework, key issues in SCM and benefits.

**8 Hours**

**Module 2 Designing the supply chain network :**

Designing the distribution network, role of distribution, factors influencing distribution, design options, distribution networks in practice, network design in the supply chain, factors affecting the network design decisions. Designing and Planning Transportation Networks, role of transportation, modes, design options, tailored transportation. **8 Hours**

**Module 3 Inventory Management & Recent issues in SCM:**

Concept, various costs associated with inventory, EOQ, buffer stock, lead time reduction, reorder point / re-order level fixation, ABC analysis, SDE/VED Analysis.

**Recent issues in SCM** Role of computer/ IT in supply chain management, CRM Vs SCM, Benchmarking concept, features and implementation, outsourcing – basic concepts, value addition in SCM. **8 Hours**

**Module 4 Purchasing and vendor management:**

Centralized and decentralized purchasing, functions and purchase policies, vendor rating/ evaluation, single vendor concept, account for materials, just in time & Kanban systems of inventory management. **8 Hours**

**Module – 5 Logistics Management:**

Logistics of part of SCM, logistics costs, logistics, sub-systems, inbound and out bound logistics bullwhip effects in logistics, distribution and warehousing management. Demand Management and Customer Service: Demand Management, CPFRP, customer service, expected cost of stock outs.

8 **Hours**

**COURSE OUTCOMES:**

The student will be able to:

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Demonstrate knowledge of the functions of logistics and supply chain management. | U |
| CO2 | To relate concepts and activities of the supply chain to actual organizations. | AP |
| CO3 | Highlight the role of technology in logistics and supply chain management. | AP |
| CO4 | Evaluate cases for effective supply chain management and its implementation. | AP |
| CO5 | Describe the basic part of SCM and demand management | AP |

**TEXT BOOKS:**


1. A Logistic approach to Supply Chain Management – Coyle, Bardi, Longley, 1st Edition, Cengage Learning.
2. Supply Chain Logistics Management, Donald J Bowersox, Dand J Closs, M Bixby Coluper,2nd Edition, TMH, 2008.


**REFERENCE BOOKS:**


1. Supply chain management, Chopra Sunil and Peter Meindl - 3rd edition, Pearson, 2007.

2. Supply Chain Management-A Managerial Approach, Amith Sinha, Herbert, 2nd edition, TMH.


**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# ALTERNATIVE FUELS FOR TRANSPOTATION

**SEMESTER:-V**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs. |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| AFT | 21ME543 | 04 | 04 | 00 | 50 | 50 | 03 |

**Course objectives:** The objectives of this course is to

1. Describe need for alternative fuels for internal combustion engine and alternative drive systems for automobiles
2. Describe principle of solar energy collection, construction of photo voltaic cells
3. Explain various properties, methods of production of Bio gas, methanol, ethanol, SVO, Bio diesel
4. Explain use of hydrogen for internal combustion engine application.
5. Describe use of various gaseous fuels for internal combustion engine application.
6. Understand various aspects of electrical and Hybrid vehicles

## MODULE-I (08 Hours)

**INTRODUCTION:** Types of energy sources, their availability, need of alternative energy sources, Non-conventional energy sources, Classification of alternative fuels and drive trains. Scenario of conventional auto fuels, oil reserves of the world. Fuel quality aspects related to emissions. Technological up gradation required business driving factors for alternative fuels. Implementation barriers for alternative fuels. Stakeholders of alternative fuels, roadmap for alternative fuels. Solar energy: Solar energy geometry, solar radiation measurement devices. Solar energy collectors, types of collectors. Direct application of solar energy, solar energy storage system. P. V. effect solar cells and characteristics. Application of solar energy for automobiles.

## MODULE-II (08 Hours)

**BIOGAS:** History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas. Production, properties, Engine performance, advantages and disadvantages of Methanol, Ethanol, Butanol, Straight vegetable oil, Biodiesel for internal combustion engine application.

## MODULE-III (08 Hours)

**HYDROGEN:** Properties and production of hydrogen, Storage, Advantages and disadvantages of hydrogen, use of Hydrogen in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Emission from hydrogen. Gaseous fuels: 08 Hours Production, properties, Engine performance, advantages and disadvantages of CNG, LNG, ANG, LPG and LFG.

## MODULE-IV (08 Hours)

**REFORMULATED CONVENTIONAL FUELS:** Introduction. Production of coal water slurry, properties, as an engine fuel, emissions of CWS. RFG, Emulsified fuels. Hydrogen-enriched gasoline. Future Alternative Fuels: Production, properties, Engine performance, advantages and disadvantages of PMF, Ammonia, Liquid-Nitrogen, Boron, Compressed Air, Water as fuel for Internal combustion Engine.

## MODULE-V (08 Hours)

**ALTERNATIVE POWER TRAINS:** Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology,

Applications of DFT. Duel fuel engine operation. Advantages and disadvantages of duel fuel technology.

**COURSE OUTCOMES:** The student will be able to

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Describe need for alternative fuels for internal combustion engine and alternative drive systems for automobiles | U |
| CO2 | Describe principle of solar energy collection, construction of photo voltaic cells | AP |
| CO3 | Explain various properties, methods of production of Bio gas, methanol, ethanol, SVO, Bio diesel | AP |
| CO4 | Explain use of hydrogen for internal combustion engine application. | AP |
| CO5 | Describe use of various gaseous fuels for internal combustion engine application. | AP |
| CO6 | Explain various aspects of electrical and Hybrid vehicles | AP |
| | **Total Number Lecture hours** | **40** |

**Text Books:** 1. Alternative Fuels- S .S. Thipse. JAICO Publishing House. 2. Non-Conventional Energy Sources- G. D. Rai Khanna Publishing New Delhi

**Reference Books:** 1. Alternative fuels for Vehicle - M. Poulton

2. Alternative fuels guide - R. Bechtold.SAE

3. Alternative energy sources -T.N Veziroglu, McGraw Hill

4. A Primer on Hybrid Electric vehicles

5. Automotive Fuels Guide - Richard L. Bechtold, SAE Publications, 1997

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

## MICRO ELECTROMECHANICAL SYSTEM

**Semester: V**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| MEMS | 21ME544 | 04 | 04 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

5. To provide detailed information about the basics of MEMS and Micro fabrication processes.
6. To impart knowledge of various sensing, actuation of materials and build adequate knowledge of polymer MEMS, Micro Fluids and some case studies.

**Module 1 Introduction to MEMS:**

History of MEMS, Intrinsic Characteristics, Devices: Sensors and Actuators. Micro fabrication: Photolithography, Thermal oxidation, Thin film deposition, etching types, Doping, Dicing, Bonding. Microelectronics fabrication process flow, Silicon based Process selection and design.

**8 Hours**

**Module 2 Piezoelectric Sensing and Actuation:**

Introduction, Cantilever Piezoelectric actuator model, Properties of Piezoelectric materials, Applications. Magnetic Actuation: Concepts and Principles, Magnetization and Nomenclatures, Fabrication and case studies, Comparison of major sensing and actuation methods. **8 Hours**

**Module 3 Polymer MEMS:**

Introduction, Polymers in MEMS (Polyimide, SU-8, LCP, PDMS, PMMA, Parylene, Others) Applications (Acceleration, Pressure, Flow, Tactile sensors). **8 Hours**

**Module 4 Micro fluidics:**

Motivation for micro fluidics, Biological Concepts, Design and Fabrication of Selective components. Channels and Valves. **8 Hours**

**Module – 5 Case Studies:**

MEMS Magnetic actuators, BP sensors, Microphone, Acceleration sensors, Gyro, MEMS Product development: Performance, Accuracy, Repeatability, Reliability, Managing cost, Market uncertainties, Investment and competition. 8 **Hours**

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Describe the sensors and actuators, basics of fabrication process. | U |
| CO2 | Describe the Knowledge of piezoelectric, actuation of materials and magnetic actuation. | AP |
| CO3 | Describe the polymers in MEMS and its applications. | AP |
| CO4 | Describe the concepts of the micro fluidics and fabrication process. | AP |
| CO5 | Learn some case studies on MEMS and uncertainty in the market. | AP |

**TEXT BOOKS:**

3. Foundation of MEMS, by Chang Liu. Pearson Education. (ISBN:9788131764756).
4. "Micro and Smart Systems" by Dr. A.K.Aatre, Prof. Ananth Suresh, Prof.K.J.Vinoy, Prof. S. Gopala krishna,, Prof. K.N.Bhat.,John Wiley Publications.
5. MEMS & Microsystems: Design and Manufacture, Tai-Ran Tsu, Tata Mc-Graw-Hill.

**REFERENCE BOOKS:**

1. Analysis and Design Principles of MEMS Devices, Minhang Bao, Elsevier, Amsterdam, the Netherlands, ISBN 0-444-51616-6.
2. Design and Development Methodologies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Gopalakrishnan, Wiley.
3. MEMS- Nitaigour Premchand Mahalik, TMH 2007

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# FLUID MACHINERY LAB

**Semester: V**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| Fluid Machinery Lab | 21MEL55 | 01 | 00 | 02 | 50 | 50 | 03 |

**OBJECTIVES:**

1. To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head.
2. To provide practical knowledge in verification of principles of fluid flow.
3. Enrich the concept of fluid mechanics and hydraulic machines.
4. Demonstrate the classical experiments in fluid mechanics and hydraulic machinery.
5. Discuss the performance characteristics of turbines and pumps.

**LIST OF EXPERIMENTS:**

**PART-A**

1) To determine total head, pump output, overall efficiency and pump efficiency of Gear Pump Test Rig.
2) To determine total head, pump output, overall efficiency and pump efficiency of the submersible pump of Submersible Pump Test Rig
3) To find out discharge of useful water and waste water. To find out the efficiency of the Hydraulic ram of Hydraulic Ram Test Rig,
4) To determine total head, pump output, overall efficiency and pump efficiency of the Jet pump
5) Pipes in Parallel and series, to study the pipes in parallel and series.

**PART-B**

6) Performance on hydraulic Turbines
    a. Pelton wheel
    b. Francis Turbine
    c. Kaplan Turbines
7) Performance hydraulic Pumps
    d. Single stage and Multi stage centrifugal pumps
    e. Reciprocating pump
8) Performance test on a two stage Reciprocating Air Compressor

9) To show the velocity and pressure variation with radius in a forced vortex flow

**OUTCOMES:**

4) Ability to use the measurement equipments for flow measurement.
5) The students will be able to understand the performance of hydraulic turbine and pumps under different working conditions
6) Able to develop the skill of experimentation techniques for the study of flow phenomena in channels/pipes.
7) To provide the students' knowledge in calculating performance analysis in turbines and pumps and can be used in power plants.
8) Students can able to understand to analyze practical problems in all power plants and chemical industries
9) Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency

**Scheme of Examination:**

ONE question from part -A: 40 Marks
ONE question from part -B: 40 Marks
Viva -Voice: 20 Marks
Total: 100 Marks

# MACHINE SHOP LAB

**Semester: V**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| Machine Shop Lab | 21MEL56 | 01 | 00 | 02 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To provide an insight to different machine tools, accessories and attachments.
2. To train students into machining operations to enrich their practical skills.
3. To inculcate team qualities and expose students to shop floor activities.
4. To educate students about ethical, environmental and safety standards.

**PART-A**

Preparation of three models on lathe involving: Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning .

**PART-B**

Cutting of V Groove/ dovetail / Rectangular groove using a shaper.

Cutting of Gear Teeth using Milling Machine.

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Identify the parts of machines and differentiate different types of machine and tools in machine shop. | U |
| CO2 | Machine and tool setup for various machining operations. | U |
| CO3 | Perform various machining operations to change the shape of a given workpiece-Facing, drilling, turning, threading cutting knurling etc. | Ap |
| CO4 | Understand the safety precautions during machining processes. | U |
| CO5 | Perform operations on lathe, milling and shaper for various engineering applications. | Ap |

U*=Understanding Ap*=Application

**SCHEME OF EXAMINATION:**

One Model from Part – A 50 Marks
One Model from Part – B 30 Marks
Viva Voce 20 Marks
Total 100 Marks

# DESIGN LAB / MACHINE DYNAMICS LAB

**Semester: V**

| Course | Code | Credits | Total Hours - 24 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Practical | SEE | CIE | |
| DESIGN LAB / MACHINE DYNAMICS LAB | 21MEL57 | 01 | 00 | 02 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

•To understand the natural frequency, logarithmic decrement, damping ratio and damping.

•To understand the balancing of rotating masses.

•To understand the concept of the critical speed of a rotating shaft.

•To understand the concept of stress concentration using Photo elasticity.

•To understand the equilibrium speed, sensitiveness, power and effort of Governor.

## PART - A

1 Determination of natural frequency, logarithmic decrement, damping ratio and damping Co-efficient in a single degree of freedom vibrating systems (longitudinal and torsional)

2 Determination of critical speed of rotating shaft.

3 Balancing of rotating masses.

4 Determination of fringe constant of Photo-elastic material using Circular disk subjected diametric compression, Pure bending specimen (four point bending)

5 Determination of stress concentration using Photo elasticity for simple components like Plate with hole under tension or bending, circular disk with circular hole under compression, 2-d crane Hook

## PART – B

1 Determination of equilibrium speed, sensitiveness, power and effort of Porter/ Proel / Hartnell Governor. (at least one)

2 Determination of principle stresses and strain in a member subjected to combined loading using strain rosettes.

3 Determination of stresses in curved beam using strain gauge

4 Experiments on Gyroscope

5 Experiment on Journal bearing ((Demonstration only)

**Course outcomes**:
On completion of this subject, students will be able

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | To understand the working principles of machine elements such as Governors, Gyroscopes etc., | **U** |
| CO2 | To identify forces and couples in rotating mechanical system components. | **AP** |
| CO3 | To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft. | **AP** |
| CO4 | To measure strain in various machine elements using strain gauges. | **AP** |
| CO5 | To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing. | **AP** |
| CO6 | To determine strain induced in a structural member using the principle of photo-elasticity. | **AP** |

U* = Understanding. AP* = Application

## REFERENCE BOOKS:

[1]"Shigley's Mechanical Engineering Design", Richards G. Budynas and J. Keith Nisbett, McGraw-Hill Education, 10th Edition, 2015.

[2] "Design of Machine Elements", V.B. Bhandari, TMH publishing company Ltd. New Delhi, 2nd Edition 2007.

[3] "Theory of Machines", Sadhu Singh, Pearson Education, 2nd Edition, 2007.

[4] "Mechanical Vibrations", G.K. Grover, Nem Chand and Bros, 6th Edition, 1996

**SCHEME OF EXAMINATION:**

Scheme of Examination:
One question from Part A: 50 Marks
One question from part B: 30 Marks
Viva- Voce: 20Marks
Total: 100 Mark

# MINI PROJECT-V

**Semester: V**

| Course | Code | Credits | Total Hours - 24 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Practical | SEE | CIE | |
| Mini project-V | 21MEMP58 | 01 | 00 | 02 | 50 | 50 | 02 |

**OBJECTIVES:**

To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

**Mini-project work:**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

# PROFESSIONAL ETHICS

**Semester: V**

| Course | Code | Credits | Total Hours – 10 | | Assessment | | Exam Duration in hours |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| **PROFESSIONAL ETHICS** | 21HSM59 | 01 | 01 | 00 | 50 | 50 | 03 |

**OBJECTIVES:**

- To enable the students to create an awareness on Engineering Ethics and Human Values,
- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

**UNIT V GLOBAL ISSUES**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

**TEXTBOOKS:**

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003. 2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

# SHARNBASVA UNIVERSITY, KALABURAGI

**Scheme of Teaching and Examination 2021-22**

**Outcome Based Education(OBE) and Choice Based Credit System (CBCS)**

**(Effective from the academic year 2021-22)**

**VI SEMESTER B.Tech. (MECHANICAL ENGINEERING)**

| Sl.No | Category | Course Code | Course Title | Teaching Dept. & Paper Setting Board | Teaching Hours/week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Total Contact Hours | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| 1 | PCC | 21ME61 | Theory of Machines | ME | 3 | | | 3 | 3 | 50 | 50 | 100 | 03 |
| 2 | PCC | 21ME62 | Design of Machine Elements | ME | 3 | 01 | | 4 | 3 | 50 | 50 | 100 | 04 |
| 3 | PEC | 21ME63X | Professional Elective-2 | ME | 3 | 01 | | 4 | 3 | 50 | 50 | 100 | 04 |
| 4 | OEC | 21XX64X | Open Elective-2 | ME | 3 | | | 3 | 3 | 50 | 50 | 100 | 03 |
| 5 | PCC | 21MEL65 | Energy Conversion Lab | ME | | | 2 | 2 | 3 | 50 | 50 | 100 | 01 |
| 6 | PCC | 21MEL66 | CAMA Lab | ME | | | 2 | 2 | 3 | 50 | 50 | 100 | 01 |
| 7 | PCC | 21MEL67 | CIM Lab | ME | | | 2 | 2 | 3 | 50 | 50 | 100 | 01 |
| 8 | MP | 21MEMP68 | Project-VI | ME | | | 2 | 2 | 2 | 50 | 50 | 100 | 01 |
| 9 | HSMC | 21HSM69 | Placement training | Humanities | | | 2 | 2 | 2 | 50 | 50 | 100 | 01 |
| **Total** | | | | | **13** | **02** | **10** | **25** | **25** | **450** | **450** | **900** | **19** |

| Category | PCC-Professional Core Course , PEC- Professional Elective Course, OEC- Open Elective Course, HSMC-Humanity and Social Science Course, MP-Mini Project, MEI-Mechanical Internship,MES- Mechanical Seminar |
|---|---|

| Professional Elective-2 | | Open Elective-2 | |
|---|---|---|---|
| 18ME631 | Finite Element Methods | 18ME641 | Computer Integrated Manufacturing |
| 18ME632 | Automation & Robotics | 18ME642 | Financial Management |
| 18ME633 | Non Traditional Machining | 18ME643 | Total Quality Management |
| 18ME634 | Additive Manufacturing | 18ME644 | Human Resource management |

## THEORY OF MACHINES

**Semester: VI**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Theory of Machines | 21ME61 | 03 | 03 | | 50 | 50 | 03 |

### COURSE OBJECTIVES

7. To provide detailed information about the basics mechanisms and knowledge of various forces acting on mechanisms.
8. To impart knowledge of velocity and force analysis and balancing of masses.
9. To provide basic knowledge of governors and gyroscope and its applications,
10. To impart knowledge of vibrations and its applications.

### Module-1

**Introduction**: Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure, degrees of freedom, Classification links, Classification of pairs based on type of relative motion,Grubler's criterion, mobility of mechanism, Groshoff's criteria.

**Mechanisms**: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism. Oldham's coupling, Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, pantograph, condition for correct steering, Ackerman steering gear mechanism.

10 hours

### MODULE -2

**Velocity Analysis by Instantaneous Center Method**: Definition, Kennedy's theorem, Determination of linear and angular velocity using instantaneous center method.

**Klein's Construction**: Analysis of velocity and acceleration of single slider crank mechanism.

6 hours

### MODULE – 3

**Static force Analysis**: Static equilibrium. Equilibrium of two and three force members. Members with two forces and torque, free body diagrams, Static force analysis of four bar mechanism and Slider-crank mechanism with and without friction.

**Balancing of Rotating Masses:** Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. 14 hours

### MODULE – 4

**Governors**: Types of governors, force analysis of Porter and Hartnell governors. Controlling force, Stability, Sensitiveness, Isochronism, Effort and Power. Gyroscope: Vectorial representation of angular motion,

**Gyroscopic couple**. Effect of gyroscopic couple on plane disc, aero plane, ship, stability of two wheelers and four wheelers, numerical problems.

10 hours

**MODULE – 5**

**Introduction & Undamped free Vibrations (Single Degree of Freedom)**

Types of vibrations, Definitions, Simple Harmonic Motion (SHM), Work done by harmonic force, Principle of super position applied to SHM. Derivations for spring mass systems, Natural frequencies of simple systems, springs in series and parallel, Tensional and transverse vibrations, Effect of mass of spring and problems.

**Vibration measuring instruments**.Sesmi instruments, Vibrometers, Accelerometer, Frequency measuring instruments, and simple numelericals. 10 hours

**COURSE OUTCOMES:**

The student will be able to

| | **Course Outcomes** | **Course Level** |
|---|---|---|
| CO1 | Describing the basic knowledge of different links, pair, chain, mechanism, structure and DOF.<br>Describing the mechanisms like Quick return motion mechanisms, Straight line motion mechanisms, Intermittent Motion mechanisms, and steering gear mechanism. | U |
| CO2 | Describing the Velocity Analysis by Instantaneous Center Method and Klein's Construction. | Ap |
| CO3 | Analyzing the Static force Analysis, and balancing of rotating masses in single plane and also in different planes. | Ap |
| CO4 | Study of governors and gyroscope | Ap |
| CO5 | Study of vibrations and vibration measuring instruments. | Ap |
| | **Total Number Lecture hours** | **50** |

**TEXT BOOKS:**


13. Theory of Machines, Sadhu Singh, Pearson Education, 2nd Edition. 2007.
14. Mechanism and Machine Theory, A. G. Ambekar PHI, 2007
15. Mechanical Vibrations, V. P. Singh, Dhanpat Rai and Company,
16. Mechanical Vibrations, G. K.Grover, Nem Chand and Bros.
17. Rattan S.S, Theory of Machines,Tata McGraw-Hill Publishing Company Ltd., New Delhi, 4th Edition, 2014.
18. Ambekar A. G., Mechanism and Machine Theory, PHI, 2009.


**REFERENCE BOOKS:**


1. Theory of Machines, Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2009.
2. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4edition, 2003.
3. Michael M Stanisic, Mechanisms and Machines-Kinematics, Dynamics and Synthesis, Cengage Learning, 2016.

4. Sadhu Singh, Theory of Machines, Pearson Education (Singapore)Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

## DESIGN OF MACHINE ELEMENTS

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Design of Machine Elements | 21ME62 | 04 | 03 | 01 | 50 | 50 | 03 |

**Course Objectives: The course aims**:

1) Study basic principles of machine design.

2) Understand the principles involved in evaluating the dimensions of a component to satisfy functional and strength requirements.

3) Learn use of catalogues and design data book.

4) Design machine elements subjected to fluctuating loading.

### MODULE 1

**Fundamentals of Machine Design** , Concept of Machine design, Types of loads, Factor of safety- its selection and significance, Review of theories of elastic failure and their applications, Basic procedure of design of machine elements,

**Review and selection of various engineering material** properties and I.S. coding for ferrous materials, Factors governing selection of Engineering materials.

### MODULE 2

**Design of machine elements under static loading**- Knuckle joint, Turn buckle and bell crank Lever.

**Types of Couplings**, Design of Muff, Rigid Coupling, flexible bushed pin type flanged coupling.

### MODULE 3

**Design of Pulley and Selection of Belts** Design of Pulley- flat and V belt pulley, Selection of flat belt, V belt as per the standard manufacturer's catalogue, Introduction to timing belts.

### MODULE 4

Introduction to Gears Gear terminology, Material selection, Types of gear failure.

**Spur Gear Gear** tooth loads, No. of teeth, Face width, Strength of gear teeth, Static beam strength (Lewis equation ) Barth equation, Dynamic tooth load (spot's equation and Buckingham equation), Wear strength (Buckingham's equation), Estimation of module based on beam strength and wear strength. Gear design for maximum power transmission capacity,

**Helical Gears** Formative number of teeth in helical gears, Force analysis, Beam and wear strength of helical gears, Effective load and design of helical gear.

## MODULE 5

**Bevel Gear** Straight tooth bevel gear terminology and geometrical relations, Guidelines for selection of dimensions and minimum number of teeth, Force analysis,

Beam and wear strength, Dynamic tooth load, Design of straight tooth bevel gears based on beam and wear strength,

**Worm Gears** Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of worm drive based on beam strength and wear strength rating, Thermal consideration in worm drive.

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | . Apply basic principles of machine design | U |
| CO2 | Design machine elements subjected to fluctuating loading. | Ap |
| CO3 | Design machine elements on the basis of strength concept. | Ap |
| CO4 | Select machine elements from Manufacturer's catalogue. | Ap |
| CO5 | Design various types of gears such as spur, helical, bevel and worm gear. | Ap |

**TEXT BOOKS:**

1)"Design of Machine Elements",V.B.Bhandari., Tata McGraw Hill Publication, 3rd Edition.

2) "Machine Design", R.K.Jain, Khanna Publication.

3) "Machine Design", Pandya Shah, Charotar Publication.

4) "Design of Machine Elements", P. Kannaiah, Scitech Publication.

5) "Machine Design A Basic Approach", Dr. S.S.wadhwa S S Jolly Dhanapat Rai and Sons.

6) "Machine Design", U.C.Jindal, Pearson Education.

7) "Design of Machine ElementsI & II", J.B.K.Das and P.L.S. Murthy ,Sapna Publishers, 2nd Edition

**REFERENCE BOOKS:**

1) "Machine Design",Hall, Holowenko Laughlin, Tata McGraw Hill Publication Schaums Outline Series.

2) "Design of Machine Element", J.F. Shigley, Tata McGraw Hill Publication.

3) “Design of Machine Element” M.F.Spotts, Pearson Education Publication, 6th Edition.
4) PSG Design data Book
5) “Mechanical Analysis and Design”, H.Burr and Cheatam, Prentice Hall Publication.
6) “Design of Transmission Systems”, P. Kannaiah, Scitech Publication.
7) “Machine Design”, P. Kannaiah, Scitech Publication, 2nd Edition.
8) “Machine Component Design”,Robert C. Juvniall, Willey Ltd, 5th Edition.
9) “Machine Design An Integrated Approach”,R.L Norton, Pearson Education Publication, 2nd Edition.
10) “Mechanical Design of Machine Elements and Machines”, Jack A Collis Henry Busby,George Staab Wiley ltd., 2nd Edition.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# FINITE ELEMENT METHOD

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 50 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Finite Element Method | 21ME631 | 04 | 03 | 01 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

11. To understand the importance of FEM and its application in solid mechanics.
12. Interpret the various methods in assembling the stiffness equations.
13. To understand and apply Finite element solutions to Structural, dynamic problems.
14. To solve temperature and heat transfer problems.

**MODULE-I** **(10 hours)**

**INTRODUCTION:** Introduction to Finite Element Method, Equilibrium equations in elasticity subjected to body force, traction forces, stress-strain relations, Plain stress and Plain strain conditions. Convergence criteria, Discretisation process, types of elements: 1D, 2D and 3D, Node numbering, Location of nodes, half band width. Application and limitations.

**MATHEMATICAL PRELIMINARIES:** Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method, Galerkin's method. Direct approach for stiffness matrix formulation of bar element. Numerical problems.

**MODULE-II** **(10 hours)**

**INTERPOLATION MODELS:** Interpolation polynomials- Linear, quadratic and cubic. Simplex, complex and multiplex elements. 2D Pascal's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian matrix for triangular and rectangular element.

**SOLUTION OF 1-D BARS:** Solutions for displacements of 1D Straight bar, stepped bars and tapered bars, reactions and stresses by using penalty approach and elimination approach.

**MODULE-III** **(12 hours)**

**HIGHER ORDER ELEMENTS:** Langrange's interpolation, higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Isoparametric, Sub parametric and Super parametric elements.

**ANALYSIS OF TRUSSES:** Stiffness matrix of Truss element. Numerical problems.

**MODULE-IV** **(08 hours)**

**BEAMS:** Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

**TORSION OF SHAFTS:** Finite element formulation of shafts, determination of stress and twists in circular shafts.

**MODULE-V** **(10 hours)**

**HEAT TRANSFER:** Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid, 1D finite element formulation using variational method. Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.

**AXISYMMETRIC SOLID ELEMENTS**: Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to various forces.

## COURSE OUTCOMES:

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Analyze the basic procedures involved in finite element method. | U |
| CO2 | Analyze a wide range two-dimensional field problem using finite element techniques and solve 1D bar problems. | Ap |
| CO3 | Use higher order elements in FEM and solve plane truss problems | Ap |
| CO4 | Apply FEM techniques and solve problems involving structures like Beams and Shafts. | Ap |
| CO5 | Apply FEM techniques and solve problems involving heat transfer and axisymmetric solid elements. | Ap |
| | **Total Number of Lecture hours** | **50** |

**TEXT BOOKS:**

1. The Finite Element Method in Engineering by Singeresu S Rao, Butterworth-Heinemann, 5th Edition, 2013
2. Finite Element Analysis by Bhavikatti, S S New age International, 3rd Edition 2015
3. Finite Element Method by J N Reddy, TMH.

**REFERENCE BOOKS:**

1. Introduction to Finite Elements in Engineering by Tirupathi R. Chandrupatla and Ashok D.Belegundu, Pearson Education, 4th Edition 2012.
2. A First Course in the Finite Element Method by Daryl L. Logan, Cengage Learning, 5th Edition 2012.
3. Text book of Finite Element Analysis by Seshu P, Prentice Hall of India
4. Concepts and Applications of Finite Element Analysis by Cook R D, Malkus D S, Plesha ME, John Wiley Sons.
5. Finite Element Methods by R Dhanraj and K Prabhakaran Nair, Oxford University Press.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# AUTOMATION & ROBOTICS

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 40 | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Hours /Week | | | | |
| | | | Lecture | Tutorial | SEE | CIE | |
| Automation & Robotics | 21ME632 | 04 | 03 | 01 | 50 | 50 | 03 |

**Course objectives:**

The course aims to,

1] To impart knowledge of Automation and different concepts of automated manufacturing Systems.
2] To understand the concepts of Robotics & its working mechanism
3] Understand the integrated parts of robots and its control systems.
4] Understanding Robot navigation systems, future & its applications
5] To introduce the students to concepts of Artificial Intelligence, Knowing the importance of AI and Integrating AI with robots.

**MODULE - 1**

**Automation**: Definition, Reasons for automation, Disadvantages of automation, Automation systems, Types of automation – Fixed, Programmable and Flexible automation, Automation strategies

**Automated Manufacturing Systems:** Components, classification and overview of manufacturing Systems, Flexible Manufacturing Systems (FMS), Types of FMS, Applications and benefits of FMS.

08 Hours

**MODULE - 2**

**Robotics:** Definition of Robot, History of robotics, Robotics market and the future prospects, Applications, Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration.

Robot motions, Joints, Work volume, Robot drive systems, Precision of movement – Spatial resolution, Accuracy, Repeatability, End effectors – Tools and grippers. 08 Hours

**MODULE - 3**

**Controllers and Actuators** Basic Control System concepts and Models, Transfer functions, Block diagrams, characteristic equation, Types of Controllers: on-off, Proportional, Integral, Differential, P-I, P-D, P-I-D controllers.

**Robot actuation and feedback components:** Position sensors – Potentiometers, resolvers, encoders, velocity sensors. Actuators - Pneumatic and Hydraulic Actuators, Electric Motors, Stepper motors, Servomotors, Power Transmission systems.

08 Hours

**MODULE - 4**

**Robot Sensors and Machine vision system:** Sensors in Robotics - Tactile sensors, Proximity and Range sensors, use of sensors in robotics.

**Machine Vision System:** Introduction to Machine vision, the sensing and digitizing function in Machine vision, Image processing and analysis, Training and Vision systems.

08 Hours

## MODULE - 5

**Robots Technology of the future:** Robot Intelligence, Advanced Sensor capabilities, Mechanical design features, Mobility, locomotion and navigation, the universal hand, system integration and networking.

**Artificial Intelligence:** Introduction, Goals of AI research, AI techniques – Knowledge representation, Problem representation and problem solving, AI and Robotics, LISP in the factory.

08 Hours

**Course Outcomes**

On completion of the course student will be able to

1. Classify various types of automation &manufacturing systems
2. Discuss different robot configurations, motions, drive systems and its performance parameters.
3. Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.
4. Explain the working of transducers, sensors and machine vision systems.
5. Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics.

**Text Books**

1. Automation, Production Systems and Computer Integrated Manufacturing M.P. Groover, Pearson Education.5th edition, 2009
2. Industrial Robotics, Technology, Programming and Applications by M.P. Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.

**Reference Books**

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
3. "Introduction to Robotics: Mechanics And Control", Craig, J. J., 2nd Ed., Addison-Wesley Publishing Company, Readong, MA, 1989.

# NON-TRADITIONAL MACHINING

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours-50 Hours /Week | | Assessment | | Exam Duration Hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Non-Traditional Machining | 21ME633 | 03 | 03 | 01 | 50 | 50 | 03 |

Course Objectives Students undergoing this course are expected to:

1. Acquire a functional understanding of non-traditional manufacturing equipment.
2. Understand the terminology used in non-traditional manufacturing industries.
3. To provide knowledge on the classification of non-traditional machining process.
4. Know about various process parameters and their influence on performance and their applications.
5. Impart knowledge on various energy involved in non-traditional machining process.

**Module-1**

**Introduction:** History, Classification, comparison between conventional and Non-conventional machining process selection. **Ultrasonic Machining (Usm):** Introduction, equipment, tool materials & tool size, abrasive slurry, cutting tool system design:- Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

**Module-2**

**Abrasive Jet Machining (Ajm):** Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number. abrasive particles per unit volume of the carrier gas, work material, stand off distance (SOD), nozzle design, shape of cut. Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining**:** Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery

**Electrochemical Machining (Ecm):** Introduction, study of ECM machine, elements of ECM process : Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics – Material removal rate, Accuracy, surface finish, ECM Tooling: ECM tooling technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

**Module-3**

**Chemical Machining (Chm):** Introduction, elements of process, chemical blanking process : Preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking, applications of chemical blanking, chemical milling (contour machining): process steps –masking, Etching, process characteristics of CHM:

material removal rate, accuracy, surface finish, Hydrogen embrittlement, advantages & application of CHM.

**Electrical Discharge Machining (Edm):** Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

**Module-4**

**Plasma Arc Machining (Pam):** Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations.

**Laser Beam Machining (Lbm):** Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

**Electron Beam Machining (EBM):** Principles, equipment, operations, applications, advantages and limitation of EBM.

**Module-5**

**Non-Destructive Testing**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism

**TEXT BOOKS:**

1. **Modern machining process,** Pandey and Shan, Tata McGraw Hill 2000

2. **New Technology,** Bhattacharya 2000

**REFERENCE BOOKS:**

1. **Production Technology,** HMT Tata McGraw Hill. 2001

CO1 Understand the need of Non Traditional Machining Processes and able to Classify various processes.

CO2 recognize the role of mechanical energy in non-traditional machining processes.

CO3 Apply the knowledge on machining electrically conductive material through electrical energy in non-traditional machining processes.

CO4 Understand the concept of machining the hard material using chemical energy and electrochemical energy.

CO5 Familiarity with various thermal energy based nontraditional machining processes.

## ADDITIVE MANUFACTURING

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Additive Manufacturing | 21ME634 | 03 | 03 | | 50 | 50 | 03 |

**Module 1**

**Introduction to Additive Manufacturing:** Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, **AM process chain:** Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing. **Classification of AM processes:** Liquid polymer system, Discrete particle system,

Molten material systems and Solid sheet system. **Post processing of AM parts:** Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

**Guidelines for process selection**: Introduction, selection methods for a part, challenges of selection

**AM Applications:** Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defence, automobile, Bio-medical and general engineering industries

**Module 2**

**System Drives and devices:** Hydraulic and pneumatic motors and their features, Electrical motors AC/DC and their features **Actuators:** Electrical Actuators; Solenoids, Relays, Diodes, Thyristors, Triacs, Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys.

**Module 3**

**POLYMERS & POWDER METALLURGY**

**Basic Concepts:** Introduction to Polymers used for additive manufacturing: polyamide, PF resin, polyesters etc. Classification of polymers, Concept of functionality, Polydispersity and Molecular weight [MW], Molecular Weight Distribution [MWD] **Polymer Processing:** Methods of spinning for additive manufacturing: Wet spinning, Dry spinning. Biopolymers, Compatibility issues with polymers. Moulding and casting of polymers, Polymer processing techniques **General Concepts:** Introduction and History of Powder Metallurgy (PM), Present and Future Trends of PM **Powder Production Techniques:** Different Mechanical and Chemical methods, Atomisation of Powder, other emerging processes.**Characterization Techniques**: Particle Size & Shape Distribution, Electron Microscopy of Powder, Interparticle Friction, Compression ability, Powder Structure, Chemical Characterization.

**Microstructure Control in Powder:** Importance of Microstructure Study, Microstructures of Powder by Different techniques

**Powder Shaping:** Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process Variables, Pressure & Density Distribution during Compaction,

Isotactic Pressing, Injection Moulding, Powder Extrusion, Slip Casting, Tape Casting.
**Sintering:** Theory of Sintering, Sintering of Single & Mixed Phase Powder, Liquid Phase Sintering Modern Sintering Techniques, Physical & Mechanical Properties Evaluation, Structure-Property Correlation Study, Modern Sintering techniques, Defects Analysis of Sintered Components
**Application of Powder Metallurgy:** Filters, Tungsten Filaments, Self-Lubricating Bearings, Porous Materials, Biomaterials etc.

**Module 4**
**NANO MATERIALS & CHARACTERIZATION TECHNIQUES:**
**Introduction:** Importance of Nano-technology, Emergence of Nanotechnology, Bottomup and Top-down approaches, challenges in Nanotechnology **Nano-materials Synthesis and Processing:** Methods for creating Nanostructures; Processes for producing ultrafine powders-Mechanical grinding; Wet Chemical
Synthesis of Nano-materials- sol-gel process; Gas Phase synthesis of Nano-materials-Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing (GPC), Chemical Vapour Condensation(CVC).
**Optical Microscopy -** principles, Imaging Modes, Applications, Limitations. **Scanning Electron Microscopy (SEM) -** principles, Imaging Modes, Applications, Limitations. **Transmission Electron Microscopy (TEM) -** principles, Imaging Modes, Applications, Limitations.**X- Ray Diffraction (XRD) -** principles, Imaging Modes, Applications, Limitations.**Scanning Probe Microscopy (SPM) -** principles, Imaging Modes, Applications, Limitations.**Atomic Force Microscopy (AFM) -** basic principles, instrumentation, operational modes, Applications, Limitations. **Electron Probe Micro Analyzer (EPMA) -** Introduction, Sample preparation, Working procedure, Applications, Limitations.

**Module 5**
**MANUFACTURING CONTROL AND AUTOMATION**
**CNC technology - An overview:** Introduction to NC/CNC/DNC machine tools, Classification of NC /CNC machine tools, Advantage, disadvantages of NC /CNC machine tools, Application of NC/CNC **Part programming:** CNC programming and introduction, Manual part programming: Basic (Drilling, milling, turning etc.), Special part programming, Advanced part programming, Computer aided part programming (APT)
**Introduction:** Automation in production system principles and strategies of automation, basic Elements of an automated system. Advanced Automation functions. Levels of Automations, introduction to automation productivity **Control Technologies in Automation:** Industrial control system. Process industry vs discrete manufacturing industries. Continuous vs discrete control. Continuous process
and its forms. Other control system components.
**Course Outcomes**
1. Understand the different process of Additive Manufacturing. using Polymer, Powder and Nano materials manufacturing.
2. Analyse the different characterization techniques.
3. Describe the various NC, CNC machine programing and Automation techniques.

**TEXT BOOKS:**
1. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2003.
2. G Odian Principles of Polymerization, Wiley Inerscience John Wiley and Sons, 4th edition, 2005

3. Mark James Jackson, Microfabrication and Nanomanufacturing, CRC Press, 2005.
4. Powder Metallurgy Technology, Cambridge International Science Publishing, 2002.
5. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008.
6. Mikell P Groover, Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Prentice Hall Inc., New Delhi, 2007.

**REFERENCE BOOKS:**

1. Wohler's Report 2000 - Terry Wohlers - Wohler's Association -2000
2. Computer Aided Manufacturing - P.N. Rao, N.K. Tewari and T.K. Kundra Tata McGraw Hill 1999
3. Ray F. Egerton , Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM , Springer, 2005.
4. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi, 2008.

# COMPUTER INTEGRATED MANUFACTURING

**Semester: VI** **Year: 2020-21**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Computer Integrated Manufacturing | 21ME641 | 04 | 03 | 01 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1] To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.

2] To make students to understand the Computer Applications in Design and Manufacturing [CAD / CAM) leading to Computer integrated systems. Enable them to perform various transformations of entities on display devices.

3] To expose students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.

4] To expose students to computer aided process planning, material requirement planning, capacity planning etc.

5] To expose the students to CNC Machine Tools, CNC part programming, and industrial robots.

6] To introduce the students to concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

## MODULE - 1

**1.Introduction to CIM and Automation:**

Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in- process, numerical problems.

5 Hours

**2. Automated Production Lines and Assembly Systems:**

Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems. 5 Hours

## MODULE – 2

**3. CAD and Computer Graphics Software**: The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry.

Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations.

5 Hours

**4. Computerized Manufacture Planning and Control System:** Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control. 5 Hours

## MODULE - 3

**5. Flexible Manufacturing Systems:**

Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. 5 Hours

**6. Line Balancing:**

Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method, Mixed Model line balancing, computerized line balancing methods. 5 Hours

## MODULE - 4.

**7. Computer Numerical Control:**

Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, Cutter radius compensations. 5 Hours

**8. Robot Technology:**

Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: material handling, processing and assembly and inspection. 5 Hours

## MODULE – 5

**9. Additive Manufacturing Systems:**

Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing. 5 Hours

**10. Future of Automated Factory:**

Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems.

5 Hours

**Course Outcomes:**

After studying this course, students will be able to:

**CO1** Able to define Automation, CIM, CAD, CAM and explain the differences between these concepts. Solve simple problems of transformations of entities on computer screen.

**CO2** Explain the basics of automated manufacturing industries through mathematical models

**CO3** Analyze the automated flow lines to reduce down time and enhance productivity.

**CO4** Explain the use of different computer applications in manufacturing, and able to prepare part programs for simple jobs on CNC machine tools and robot programming.

**CO5** Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.

**Text Books:**

1. Automation, Production Systems and Computer-Integrated Manufacturing, by Mikell P Groover, 4th Edition, 2015, Pearson Learning.
2. CAD / CAM Principles and Applications by P N Rao, 3rd Edition, 2015, Tata McGraw-Hill.
3. CAD/CAM/CIM, Dr. P. Radhakrishnan, 3rd edition, New Age International Publishers, New Delhi.

**Reference Books:**

1. "CAD/CAM" by Ibrahim Zeid, Tata McGraw Hill.
2. "Principles of Computer Integrated Manufacturing", S.Kant Vajpayee, 1999, Prentice Hall of India, New Delhi.
3. "Work Systems And The Methods, Measurement And Management of Work", Groover M. P.,Pearson/Prentice Hall, Upper Saddle River, NJ, 2007.
4. "Computer Automation in Manufacturing", Boucher, T. O., Chapman & Hall, London, UK,1996.
5. "Introduction to Robotics: Mechanics And Control", Craig, J. J., 2nd Ed., Addison-Wesley Publishing Company, Readong, MA, 1989.
6. Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition, by Nicolas Windpassinger, Amazon.
7. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
8. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
9. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011
10. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist

# FINANCIAL MANAGEMENT

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Financial Management | 21ME642 | 03 | 04 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To familiarize the students with basic concepts of financial management and financial system.
2. To understand concept of time value of money and its uses.
3. To evaluate the investment proposals.
4. To analyze capital structure and dividend decision.
5. To understand the management of working capital in an organization.

**MODULE-1** **(08 HOURS)**

**INTRODUCTION TO FINANCIAL MANAGEMENT**

Financial management – Introduction to financial management, objectives of financial management. Changing role of finance managers. Interface of Financial Management with other functional areas.

Emerging Issues in financial management: Risk management, Behavioral finance and financial engineering. Introduction to Financial System. Financial markets, Financial Instruments, Financial institutions and financial services. Introduction to derivatives.

**MODULE-2**

**(08 HOURS)**

**TIME VALUE OF MONEY**

Time value of money –Future value of single cash flow & annuity, present value of single cash flow, annuity & perpetuity. Simple interest & Compound interest, Capital recovery & loan amortization. (Theory & Problem). Case Study on Loan amortization

**MODULE – 3** **(08 HOURS)**

**SOURCES OF FINANCING & COST OF CAPITAL**

**SOURCES OF FINANCING**: Shares, Debentures, Term loans, Lease financing, Hybrid financing, Venture Capital, Angel investing and private equity, Warrants and convertibles (Theory Only).

**COST OF CAPITAL:** Basic concepts. Cost of debenture capital, cost of preferential capital,

cost of term loans, cost of equity capital (Dividend discounting and CAPM model) - Cost of retained earnings Determination of Weighted average cost of capital (WACC) and Marginal cost of capital. (Theory & Problem). Case Study on WACC.

**MODULE – 4 (08 HOURS)**

**INVESTMENT DECISIONS**

Investment decisions – Capital budgeting process, Investment evaluation techniques – Net present value, Internal rate of return, Modified internal rate of return, Profitability index, Payback period, discounted payback period, accounting rate of return (Theory & Problem). Capital rationing; Risk analysis in capital budgeting (Theory only). Case Study on replacement of capital project.

**MODULE – 5 (08 HOURS)**

**WORKING CAPITAL MANAGEMENT**

Working capital management – factors influencing working capital requirements - Current asset policy and current asset finance policy Determination of operating cycle and cash cycle - Estimation of working capital requirements of a firm. (Does not include Cash, Inventory & Receivables Management). Case study on Working Capital Determination

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Understand the basic financial concepts | U |
| CO2 | Apply time value of money. | Ap |
| CO3 | Evaluate the investment decisions | Ap |
| CO4 | Analyze the capital structure and dividend decisions. | Ap |
| CO5 | Estimate working capital requirements. | Ap |

U*=Understanding Ap*=Application

**TEXT BOOKS:**

1. Financial Management -Prasanna Chandra, 9/e, TMH.
2. Financial Management,Khan M.Y.& Jain P. K, 7/e, TMH
3. Financial Management ,I M Pandey, 11th Edition, Vikas Publishing House.

**REFERENCE BOOKS:**

1. Principles of corporate finance, Brealey and Myers, 9/e,TMH.
2. Financial Management, Rathod, Babitha Thimmaiah,Harish Babu, HPH.
3. Fundamentals of Financial Management, Brigham & Houston, Cengage Learning.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# TOTAL QUALITY MANAGEMENT

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| TOTAL QUALITY MANAGEMENT | 21ME643 | 03 | 03 | 00 | 50 | 50 | 03 |

**Course Learning Objectives:**

- Understand various approaches to TQM
- Understand the characteristics of quality leader and his role.
- Develop feedback and suggestion systems for quality management.
- Enhance the knowledge in Tools and Techniques of quality management.

**MODULE-1** **8 Hours**

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, benefits of TQM. Quality Management Systems: Introduction, **Benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements.** Environmental Management Systems (EMS): Definition, Basic EMS, EMS under ISO 14001, Costs and Benefits of EMS..

**MODULE-2** **8 Hours**

Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality and feedback.

**MODULE-3** **8 Hours**

Continuous Process Improvement: process, the Juran trilogy, quality circle, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

**MODULE-4** **8 Hours**

Statistical Process Control: Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.

**MODULE-5** **8 Hours**

Total Productive Maintenance (TPM): Definition, Types of Maintenance, Steps in introduction of TPM in an organization, Pillars of TPM – 5S, Jishu Hozen, Quality Maintenance, Planned Maintenance.

Quality by Design (QbD): Definition, Key components of QbD, Role of QbD in Pharmaceutical Industry, Benefits and Challenges of QbD.

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Explain the various approaches of TQM. | U |
| CO2 | Infer the customer perception of quality. | AP |
| CO3 | Analyze customer needs and perceptions to design feedback systems. | AP |
| CO4 | Apply statistical tools for continuous improvement of systems. | AP |
| CO5 | Apply the tools and technique for effective implementation of TQM. | AP |

**Text Books:**

1. Total Quality Management: Dale H. Bester field, Publisher -Pearson Education India, Edition 07.
2. Total quality management: Author H D RAMCAHNDRA, VIKRAM SINH PACHPUTE, Edition 2014-15

**Reference Books:**

1. Managing for Quality and Performance Excellence by James R.Evans and Williuam M Lindsay,9th edition, Publisher Cengage Learning.
2. A New American TQM, four revolutions in management, ShojiShiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
3. Organizational Excellence through TQM, H. Lal, New age Publications, 2008.

**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# HUMAN RESOURCE MANAGEMENT

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hours |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| Human Resource Management | 21ME644 | 03 | 04 | 00 | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To understand the HRM concepts and theory.
2. To obtain an overview of various HRM functions and practices.
3. To gain an insight into the basic statutory provisions.

**MODULE-1 (08 HOURS)**

**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT**

Introduction, meaning, nature, scope of HRM - Importance and Evolution of the concept of HRM - Major functions of HRM - Principles of HRM

**Human Resource Planning:** Objectives, Importance and process of Human Resource Planning, Effective HRP.

**MODULE-2 (08 HOURS)**

**JOB ANALYSIS & RECRUITMENT**

**JOB ANALYSIS:** Meaning, process of Job Analysis, methods of collecting job analysis data, Job Description and Job Specification, Role Analysis.

**RECRUITMENT:** Definition, Constraints and Challenges, Sources and Methods of Recruitment, New Approaches to recruitment.

**MODULE – 3 (08 HOURS)**

**SELECTION & PLACEMENT, TRAINING AND DEVELOPMENT**

**SELECTION:** Definition and Process of Selection.

**PLACEMENT:** Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation.

**TRAINING AND DEVELOPMENT:** Training v/s development, Training v/s Education, Systematic Approach to Training, Training Methods.

**MODULE – 4 (08 HOURS)**

**PERFORMANCE APPRAISAL & COMPENSATION**

**PERFORMANCE APPRAISAL:** Concept of Performance Appraisal, the Performance Appraisal Process, Methods of Performance Appraisal.

**COMPENSATION:** Objectives of Compensation Planning, Job Evaluation, Compensation Pay Structure in India.

**MODULE – 5 (08 HOURS)**

**EMPLOYEE WELFARE, EMPLOYEE GRIEVANCES & DISCIPLINE:**

**EMPLOYEE WELFARE:** Introduction, Types of Welfare Facilities and Statutory Provisions.

**EMPLOYEE GRIEVANCES:** Employee Grievance procedure, Grievances Management in Indian Industry.

**DISCIPLINE:** Meaning, approaches to discipline, essential of a good disciplinary system, managing difficult employees

**COURSE OUTCOMES:**

The student will be able to

| | Course Outcomes | Course Level |
|---|---|---|
| CO1 | Understanding of HRM functions, principles, Job analysis that facilitates students to design a job description and job specification for various levels of employees | U |
| CO2 | Synthesize knowledge on effectiveness of recruitment process, sources & understanding of systematic selection procedure. | Ap |
| CO3 | Identify the various training methods and design a training program | Ap |
| CO4 | Understand the concept of performance appraisal process in an organization. | Ap |
| CO5 | List out the regulations governing employee benefit practices. | Ap |

U*=Understanding Ap*=Application

**TEXT BOOKS:**


19. Human Resources Management: A South Asian Perspective, Denski/Griffin/Sarkar-Cengage Learning, 2012.
20. Human Resource Management – Rao V. S. P, Excel BOOKS, 2010 “Manufacturing process-2”, Kestoor Praveen, Suggi publishing,5th edition 2013.
21. Human Resource Management – Dr. T.PRenukaMurthy HPH.

**REFERENCE BOOKS:**


1. Human Resource Management - John M. Ivancevich, 10/e, McGraw Hill.
2. Human Resource Management in practice - Srinivas R. Kandula, PHI, 2009
3. Managing Human Resources - Luis R Gomez-Mejia, David B. Balkin, Robert L. Cardy,6/e, PHI, 2010


**SCHEME OF EXAMINATION:**

Two question to be set from each module. Students have to answer five full questions, choosing at least one full question from each module.

# ENERGY CONVERSION LAB

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 Hours /Week | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|
| | | | Practical | SEE | CIE | |
| EC LAB | 21MEL65 | 01 | 03 (1 Hour Instruction+ 2 Hours Laboratory) | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. This course will provide a basic understanding of fuel properties and its measurements using various types of measuring devices
2. Energy conversion principles, analysis and understanding of I C Engines will be discussed. Application of these concepts for these
3. machines will be demonstrated. Performance analysis will be carried out using characteristic curves.
4. Exhaust emissions of I C Engines will be measured and compared with the standards.

## PART – A

1. Lab layout, calibration of instruments and standards to be discussed
2. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleveland's (Open Cup) Apparatus.
3. Determination of Calorific value of solid, liquid and gaseous fuels.
4. Determination of Viscosity of a lubricating oil using Redwoods, Sayboltand Torsion Viscometers.
5. Analysis of moisture, volatile matter, ash content and fixed carbon of solid and liquid fuel samples
6. Valve Timing/port opening diagram of an I.C. Engine

## PART – B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiency, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio, heat balance sheet for
   a. Four stroke Diesel Engine
   b. Four stroke Petrol Engine
   c. Multi Cylinder Diesel/Petrol Engine, (Morse test)
   d. Two stroke Petrol Engine
   e. Variable Compression Ratio I.C. Engine.
2. Measurements of Exhaust Emissions of Petrol engine.
3. Measurements of Exhaust Emissions of Diesel engine
4. Demonstration of $p\theta$ , pV plots usingComputerized IC engine test rig

**COURSE OUTCOMES:**

1. Perform experiments to determine the properties of fuels and oils.
2. Conduct experiments on engines and draw characteristics.
3. Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
4. Identify exhaust emission, factors affecting them and report the remedies.

5. Determine the energy flow pattern through the I C Engine
6. Exhibit his competency towards preventive maintenance of IC engines.

**REFERENCE BOOKS:**

1. A first course in the Finite element method, Daryl L Logan,Thomason, Third Edition
2. Fundaments of FEM, Hutton – McGraw Hill, 2004 3. Finite Element Analysis, George R. Buchanan, Schaum Series

**SCHEME FOR EXAMINATION:**

Scheme of Examination:
ONE question from part -A: 50 Marks
ONE question from part -B: 30 Marks
Viva –Voice : 20 Marks
Total: 100 Marks

## MODELING AND ANALYSIS LAB (FEA)

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|
| | | | Hours /Week | | | |
| | | | Practical | SEE | CIE | |
| FEA LAB | 21MEL66 | 01 | 03 (1 Hour Instruction+ 2 Hours Laboratory) | 50 | 50 | 03 |

**COURSE OBJECTIVES**

1. To acquire basic understanding of Modeling and Analysis software
2. To understand the different kinds of analysis and apply the basic principles to find out the stress and other related parameters of bars, beams loaded with loading conditions.
3. To lean to apply the basic principles to carry out dynamic analysis to know the natural frequency of different kind of beams.

**PART – A**

1. Bars of constant cross section area, tapered cross section area and stepped bar
2. Trusses – (Minimum 2 exercises of different types)
3. Beams – Simply supported, cantilever, beams with point load, UDL, beams with varying load etc(Minimum 6 exercises different nature)

**PART – B**

1) Thermal Analysis (Minimum 4 exercises of different types)
2) Dynamic Analysis to find
   a) Fixed – fixed beam for natural frequency determination
   b) Bar subjected to forcing function
   c) Fixed – fixed beam subjected to forcing function

3. Stress analysis of a rectangular plate with a circular hole

**COURSE OUTCOMES:**

1. Demonstrate the basic features of an analysis package.

2. Use the modern tools to formulate the problem, and able to create geometry, descritize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with differentloading conditions.
3. Demonstrate the deflection of beams subjected to point, uniformly distributed and varying loads further to use the available results to draw shear force and bending moment diagrams.
4. Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.
5. Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

**REFERENCE BOOKS:**

1. A first course in the Finite element method, Daryl L Logan,Thomason, Third Edition
2. Fundaments of FEM, Hutton – McGraw Hill, 2004 3. Finite Element Analysis, George R. Buchanan, Schaum Series

**SCHEME FOR EXAMINATION:**

One Question from Part A – 20 Marks (10 Write up +10 Executions)
One Question from Part B - 20 Marks (10 Write up +10 Executions)
Viva-Voce - 10 Marks
Total 50 Marks

## CIM LAB

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 40 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | SEE | CIE | |
| CIM LAB | 21MEL67 | 01 | 03 | 01 | 50 | 50 | 03 |

**Course Objectives:**

**1** To expose the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-codes.
**2** To educate the students on the usage of CAM packages.
**3** To make the students understand the importance of automation in industries through exposure to FMS, Robotics, and Hydraulics and Pneumatics.

## Part-A

**Manual CNC part programming** for 2 turning and 2 milling parts. Selection and assignment of tools, correction of syntax and logical errors, and verification of tool path.

**CNC part programming using CAM packages**. Simulation of Turning, Drilling, Milling operations.
3 typical simulations to be carried out using simulation packages like: **CademCAMLab-Pro, Master- CAM.**
Program generation using software. Optimize spindle power, torque utilization, and cycle time. Generation and printing of shop documents like process and
cycle time sheets, tool list, and tool layouts. Cut the part in single block and auto mode and measure the virtual part on screen.
Post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC and MISTUBISHI.

### Part B

**(Only for Demo/Viva voce)**
**FMS (Flexible Manufacturing System)**: Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe,
milling with loading unloading arm and ASRS to be carried out on simple components.

**(Only for Demo/Viva voce)**
**Robot programming:** Using Teach Pendent & Offline programming to perform pick and place, stacking of objects (2 programs).
**Pneumatics and Hydraulics, Electro-Pneumatics:** 3 typical experiments on Basics of these topics to be conducted.

**Course Outcomes:**
After studying this course, students will be able to:
**CO 1:** Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.
**CO 2:** Generate CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.
**CO 3:** Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning
Thread cutting etc.
**CO 4:** Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.
**CO 5:** Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time.
**CO 6:** Understand & write programs for Robotcontrol;understand the operating principles of hydraulics, pneumatics and electropneumatic systems. Apply this knowledge to automate & improve efficiency of manufacturing.

**Scheme for Examination:**
Two Questions from Part A - 60 Marks (30 +30)
Viva-Voce - 20 Marks
Total: 80 Marks

# MINI PROJECT-VI

**Semester: VI** **Year:**

| Course | Code | Credits | Total Hours - 24 Hours /Week | | Assessment | | Exam Duration in hrs |
|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | SEE | CIE | |
| Mini project-VI | 21MEMP68 | 01 | 00 | 02 | 50 | 50 | 02 |

**OBJECTIVES:**

To introduce fundamental concepts and analysis techniques in engineering to students across all disciplines.

**Mini-project work:**

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.